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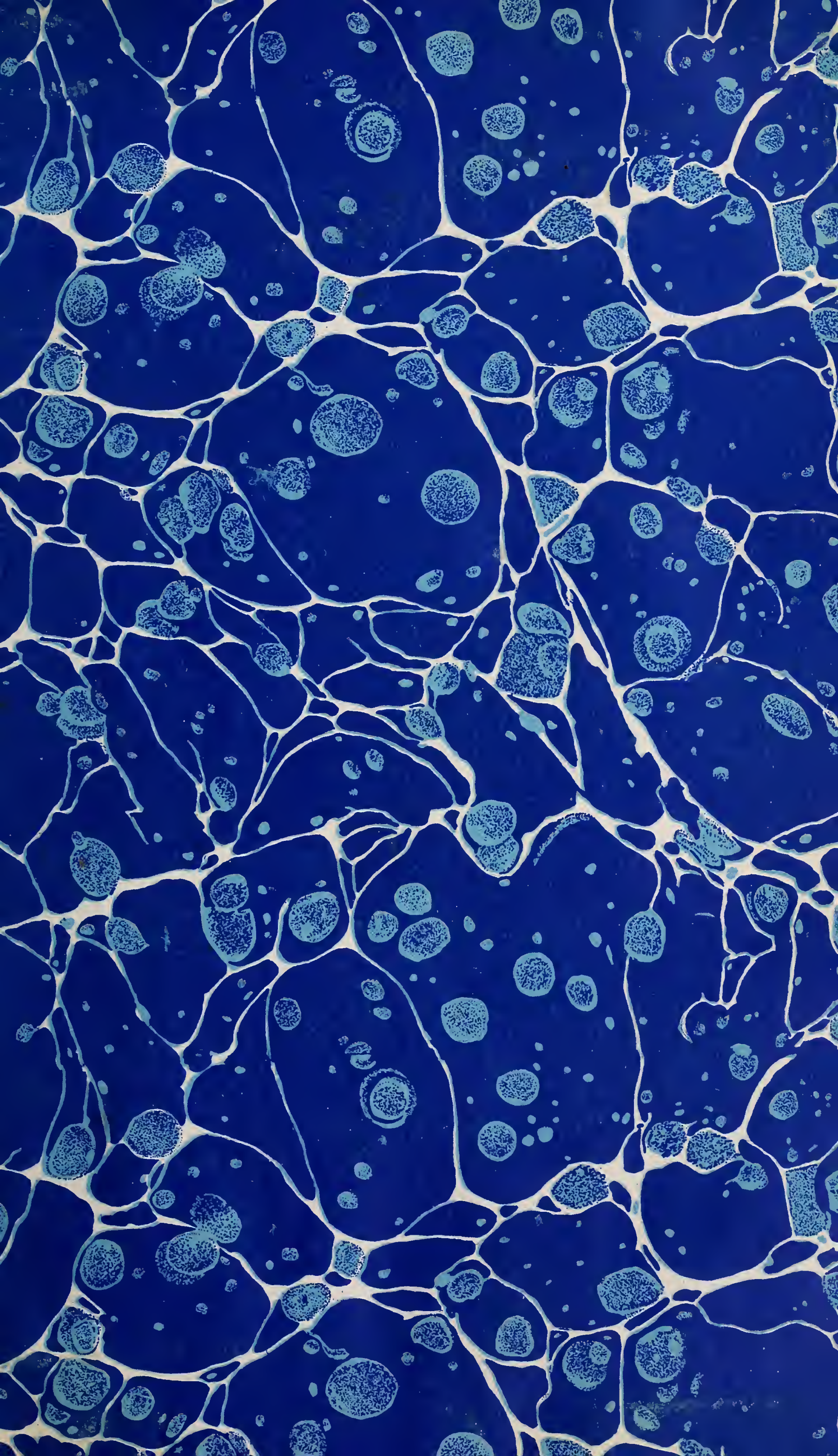

U. S. DEPARTMENT OF AGRICULTURE,

BUREAU OF FORESTRY—BULLETIN No. 51.

GIFFORD PINCHOT, Forester.

REPORT

ON THE

CONDITION OF TREATED TIMBERS LAID IN TEXAS, FEBRUARY, 1902.

BY

HERMANN VON SCHRENK,

In Charge of Forest Products, Bureau of Forestry.

WASHINGTON:
GOVERNMENT PRINTING OFFICE.
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BUREAU OF FORESTRY.

GIFFORD PINCHOT, *Forester.*

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LETTER OF TRANSMITTAL.

U. S. Department of Agriculture,
Bureau of Forestry,
Washington, D. C., June 20, 1904.

Sir: I have the honor to transmit herewith a paper entitled "Report on the Condition of Treated Timbers Laid in Texas, February, 1902," by Dr. Hermann von Schrenk, in charge of Forest Products in the Bureau of Forestry, and to recommend its publication as Bulletin No. 51 of the Bureau of Forestry.

The three plates which accompany the report are necessary for its proper illustration.

Very respectfully,

Gifford Pinchot,
Forester.

Hon. James Wilson,
Secretary of Agriculture.

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ILLUSTRATIONS.

[These ties were laid in February, March, April, and May, 1902, and had consequently been in position at least eighteen months when the photographs were taken.]

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Plate I. Fig. 1.—Untreated beech ties with a timber-destroying fungus (*Polystictus versicolor* Fr.) growing on the ends—an evidence of decay. Fig. 2.—Untreated red oak ties with a timber-destroying fungus growing on them. One tie is badly split ---------- 14

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REPORT ON THE CONDITION OF TREATED TIMBERS LAID IN TEXAS, FEBRUARY, 1902.

INTRODUCTION.

The increasing scarcity of long-lived timbers is making itself felt more and more every day, and the question how best to preserve timbers which in their natural condition ordinarily last but a very short time has aroused increasing interest during the last few years. There are a large number of processes which it is claimed preserve wood to a greater or less extent. Some of these—as, for instance, the creosote and the zinc-chlorid processes—have been extensively used for many years, both in this country and in Europe, and a large number of different kinds of timber have been subjected to treatment. Nevertheless, there is, except possibly in the case of the creosote treatment, little tabulated information either as to the extent to which these methods of treatment actually prolong the life of any particular timber or as to the comparative value of the different processes. That creosote (more properly, tar oil), as well as zinc chlorid, copper sulphate, corrosive sublimate, and other metallic salts preserve wood against decay for a longer or shorter period, has indeed been established beyond doubt. But whether, for example, mercuric chlorid will preserve loblolly pine so that instead of lasting two years in Texas it will last four, or eight, or twelve years, has never been ascertained.

To secure definite information concerning certain of these processes which appeared to be particularly promising, a series of tests was begun about two years ago by the Bureau of Plant Industry.[a] By these tests it was sought to determine (1) What are the lengths of life of various kinds of untreated timbers under similar conditions? and (2) To what extent are these lengths of life prolonged by various treatments?

The most serious difficulty in making such tests is that the length of life of untreated timbers is under ordinary circumstances from five to ten years, while for treated timbers probably double that time would be required to reach results of any value. It was important to find, if possible, some means of reducing this time. The deteriorating changes which take place in timbers treated with tar oil or metallic salts consist either in the leaching out of the salts soluble in water or in the volatilization of hydrocarbon compounds. These changes are favored by excessive moisture and excessive heat. Heat and moisture likewise promote the growth and development of timber-destroying fungi in untreated wood. It was thought, therefore, that by selecting a region where there would be long periods of high temperature and heavy rainfall it might be possible to hasten the deteriorating changes in the treated timbers, and at the same time to accelerate the activity of the decay-producing factors in the untreated wood.

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[a] See Bulletin No. 14, Bureau of Plant Industry, Department of Agriculture, "Decay of Timber and Methods of Preventing It," p. 29.

After considerable investigation a region in southeastern Texas was selected for the test. In this region the average temperature for July and August is about 94°, and the average rainfall for the months of June, July, and August is about 14 inches. At Houston and Beaumont, respectively, the average temperature and rainfall during these months for five years were as follows:

TABLE I.—*Average temperature and rainfall in southeastern Texas.*

	Houston.	Beaumont.
Average maximum daily temperature:	° *F.*	° *F.*
July	91.7	94.3
August	93.5	95.2
Average rainfall:	*Inches.*	*Inches.*
June	4.88	4.98
July	4.13	5.02
August	4.41	4.71
Annual	45.91	46.61

In this region the average length of life of untreated loblolly pine ties is about one to two years. Fungi of all kinds grow with enormous rapidity, favored by the humid condition of the atmosphere and the soil.

The tests were made on railroad ties because wood in this form is exposed to decay-producing influence at all times, since the position of a tie in the ground, partially surrounded by soil, prevents the evaporation of water and correspondingly promotes the development of the destructive fungi, and because salts or tar-oil products are apt to escape more rapidly from a tie than from any other form of wood.

TEXAS TRACK.

KINDS OF TIMBER USED.

During the summer and fall of 1901, as reported in Bulletin No. 14 (page 29) of the Bureau of Plant Industry, preparations were made for a test on the Beaumont division of the Gulf, Colorado and Santa Fe Railway. Treated and untreated timbers from various parts of the United States were contributed by the railroad companies mentioned on pages 31 and 32, Bulletin No. 14, Bureau of Plant Industry, and were treated without charge by the preserving companies whose reports giving details of the several treatments are contained in the Appendix of the present bulletin. They were shipped to Somerville, Tex., where they were provided with dating nails and nails indicating the kinds of timber. All were then sent eastward from Somerville and laid in a continuous stretch of track about 2½ miles long. They began to arrive at Somerville during the fall of 1901, and were laid during February, March, April, and May, 1902. The ties were made out of the timbers indicated below. The sources of the timber are given as nearly as possible, and also the marks stamped on the nails to indicate the kind of timber. It is hoped that these marks will be adopted generally in all tests of this kind.

The American Railway Engineering and Maintenance of Way Association recommended the adoption of dating nails in 1902.[a]

It was impossible to include in this test all the kinds of timber which it might have been desirable to subject to it. Only such timbers were used as were readily obtainable from the railroads which contributed ties. It was not known at what time of the year they were cut, or whether they were seasoned before treatment. There was consequently no opportunity to secure from this test data concerning the effect of seasoning before treatment and the effect of the time of cutting on the length of life.

The kinds of wood used, the States in which the timbers were cut, and the marks employed were as follows:

TABLE II.—*Timbers used in experimental track.*

Kind of wood.	Source.	Mark.	Kind of wood.	Source.	Mark.
White oak	Missouri, Illinois	W.	Tamarack	Wisconsin	T.
Red oak	Missouri	R. O.	Hemlock	do	H.
Black oak	do	B. O.	Longleaf pine	Texas	L.
Spanish oak	do	S. O.	Shortleaf pine	do	S.
Turkey oak	do	Y. B.	Loblolly pine	do	L. L.
Willow oak	do	W. O.	Redheart pine	do	R. H.
Beech	Indiana	B.			

The details of the treatment which the various ties received are given in the Appendix. The timbers submitted had to be treated at various preserving plants, under the supervision of the persons operating these plants. It is to be regretted that, owing to the conditions under which this first test had to be made, it was in most cases not possible to treat the ties exactly as they would have been treated in the course of regular commercial operations. It is likewise to be regretted that the timbers were not always of the best quality. In certain instances the test ties were made parts of regular runs, and so received exactly the same treatment as was being given to ties for ordinary use by various railroad companies. In certain other instances the various kinds of timber were lumped together, because they were too few to be treated separately, and as a result it is probable that some of the timbers did not receive the best treatment. A careful study of the report sent by the individual treating companies, as given in the Appendix, will show in detail under what conditions the various classes of timber were treated.

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[a] See letter of the president, November 12, 1902, in report of committee on ties, Bulletin No. 43, American Railway Engineering and Maintenance of Way Association, September, 1903.

THE FINISHED TRACK.

The experimental track, starting at a point east of the station of Pelican, on the Gulf, Colorado and Santa Fe Railway, and extending westward, was completed in May, 1902. All ties of one kind of timber were laid together—for example, in the case of white oak the order was, white oak Burnettized, white oak Allardyce, white oak untreated, white oak Wellhouse, etc. In this way approximately the same conditions were obtained for the same timbers. A detailed plan of the manner in which the ties were laid is given below.

Each treated tie was marked with at least three nails. These nails were made of heavy wire coated with zinc. In the heads were stamped the letters or marks showing the kind of timber, the kind of treatment and the year in which the ties were laid. In some instances a fourth nail was added, with one or two stars, the single star indicating that the timber had been treated at Chicago, the double star that it had been treated at Beaumont, Tex. The nails were placed about 4 inches outside of the rail, on the south side of the track, where they would not be concealed by the ballast. When finished the track was heavily ballasted in the middle, leaving the ends of the ties exposed to the air. The ballast was composed largely of densely packed sand. On both sides of the track there is a continuous stretch of pine forest, by which the track is more or less shaded during the day. No tie-plates were used on the test ties. The track was laid with 60 and 61 pound rails.

The traffic over the track is mostly in a west-bound direction. For the past year the gross tonnage passing over the Beaumont division amounted to 306,000,000 tons, equivalent to about 2,000,000 tons per mile during the year, or 166,000 tons per month. The maximum wheel load per axle of locomotive passing over the track was about 35,000 pounds.

FIRST INSPECTION OF TRACK, NOVEMBER 30, 1903.

GENERAL CONDITION.

A careful inspection of the experimental track was made on November 30, 1903. Each tie was examined, and notes were made as to the extent to which the ties had worn, checked, or decayed. The general condition of the track was good. Most of the ties had worn very little, and with the exception of one species of timber they had not cracked to any considerable extent. Almost all of the untreated timbers showed signs of decay, some more and some less, which indicated that the selection of this part of the country for the purpose of getting rapid comparative results was a good one.

Of the treated timbers, those treated with the Hasselmann (or Barschall) process showed some signs of decay. These were ties included in a run (No. 2) which was stated not to have received the proper treatment. (See Appendix.)

A certain number of ties, which had been treated by the zinc creosote process at Beaumont, Tex., but which had been subjected to an excessive heating during the treatment, had to be removed very soon after being placed. They were brittle when they arrived, and should not be considered as furnishing a fair test of the process. They really ought not to have been laid in the track at all. These ties have shown what is probably the most interesting result so far obtained from the test. It will be noted that the oak ties treated at Beaumont were treated in the same run with pine, tamarack, beech, etc., and that in all probability the high temperature to which the ties were subjected injured the oak wood materially.

The oak ties which were submitted to the overheated treatment (indicated by the double star [**] in the tables) were soft and exceedingly brittle when they reached the place where they were to be laid. A number of them were broken when thrown from the cars. The remainder, both those which have been removed and those which are now ready to be removed from the track, have all been broken and shattered, indicating that during the process of treating the strength of the timber had been materially affected. The results of the test should serve as a warning to all who are interested in the treatment of timber to avoid the excessive heating of the wood while it is in the cylinder.

DETAILED ACCOUNT OF CONDITION OF TIES.

The following is a detailed statement of the number and condition of the various ties in the experimental track at the time of inspection. They are discussed in practically the same order as that of Table III. The fungi found growing on some of the ties are species found generally over the United States.

Beech, untreated.—Of the 87 untreated sawed beech ties laid, 38 had fungi on them. Of these fungi the most common is the grayish white fungus (*Polystictus versicolor* Fr.) often found on beech wood throughout the beech-growing belt. In most cases the fungi were growing with considerable vigor, and covered the entire end of the tie. Pl. I, fig. 1, shows the ends of several beech ties, on one of which in particular this fungus is growing in great luxuriance. The fact that fungi have attacked such a large number of ties shows that the untreated beech timber is decaying with great rapidity, and it is probable that within another year practically all of the untreated beech ties will be partially decayed. The ties have worn but little under the rail.

Beech, Wellhouse.—All of the 100 hewn ties treated by the Wellhouse process at Chicago were in excellent condition, and showed very little wear.

Beech, Burnettized.—The 99 sawed beech ties treated at Chicago with zinc chlorid were all in good condition, and showed very little wear.

Beech, Barschall.—Of the 98 sawed beech ties which received the Barschall treatment at Somerville, 20 had the grayish white fungus (*Polystictus versicolor* Fr.) growing on the ends. This indicates that they are beginning to decay. The ties show but little wear. (See Appendix, p. 41.)

Beech, Allardyce.—The 50 beech ties treated at Somerville by the Allardyce process are in an excellent state of preservation, and show but little wear.

Beech, zinc creosote, overheated.—There are also 50 sawed beech ties which were treated by the zinc creosote process at Beaumont, but were subjected to an unusual degree of heat. Many of these ties were badly cracked and shattered, and many of them will have to be removed in the near future. Without doubt the extreme heat to which these ties were subjected during the treatment is the reason for their being so badly broken.

Red oak, Burnettized.—The 20 hewn red oak ties treated at Somerville with zinc chlorid were in good condition and showed very little wear. Some of them are very badly checked.

Red oak, Burnettized.—A second lot of 86 sawed 7 by 8 red oak ties, treated at Chicago were likewise in excellent condition so far as preservation is concerned.

Red oak, untreated.—Of the 93 untreated red oak ties, 16 had the timber-destroying fungus (*Polystictus versicolor* Fr.) on them, and 23 were very badly split, probably because of unequal drying out. Pl. I, fig. 2, shows several of these ties and the extent to which they have cracked.

Red oak, Barschall.—The 19 hewn red oak ties treated by the Barschall process were all in good condition, and showed little wear.

Red oak, Wellhouse.—All of the 20 hewn red oak ties treated by the Wellhouse process at Somerville were in good condition, and showed little wear.

Red oak, Allardyce.—The 10 hewn red oak ties treated by the Allardyce process were in a splendid state of preservation, and showed neither wear nor checking to any considerable extent.

Turkey oak, untreated.—Out of the 20 hewn turkey oak ties, 6 had the gray fungus (*Polystictus versicolor* Fr.) growing on them, indicating that they are beginning to decay. The ties are wearing well.

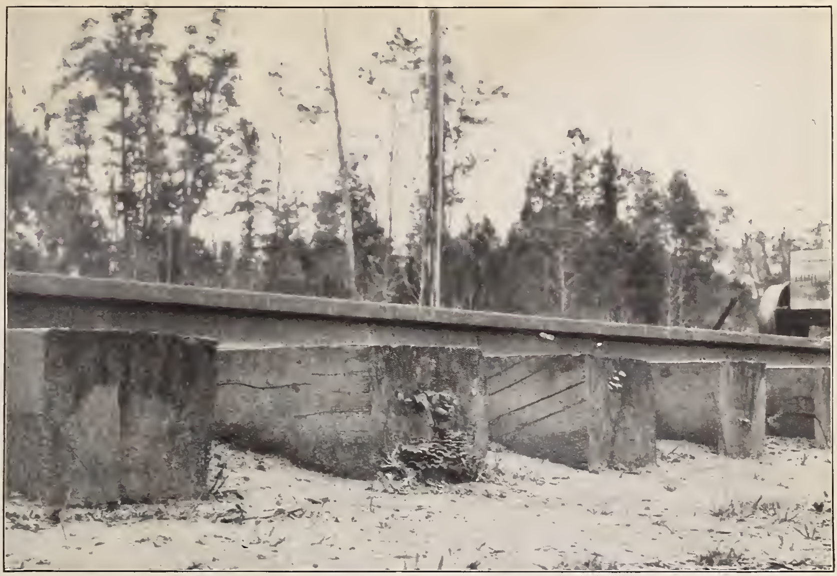

FIG. 1.—UNTREATED BEECH TIES WITH A TIMBER-DESTROYING FUNGUS (POLYSTICTUS VERSICOLOR FR.) GROWING ON THE ENDS—AN EVIDENCE OF DECAY.

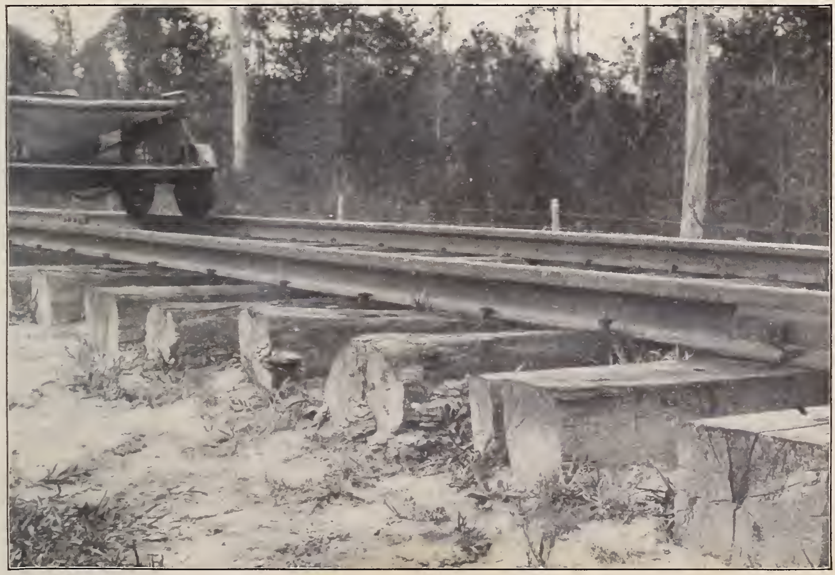

FIG. 2.—UNTREATED RED OAK TIES WITH A TIMBER-DESTROYING FUNGUS GROWING ON THEM. ONE TIE IS BADLY SPLIT.

Turkey oak, Wellhouse.—There are 20 hewn turkey oak ties which were treated by the Wellhouse process at Somerville. Both the wear and the preservation are good.

Turkey oak, Barschall.—The 19 hewn turkey oak ties treated by the Barschall process were all in a good state of preservation, and showed little wear.

Turkey oak, Burnettized.—The 20 turkey oak ties treated at Somerville with zinc chlorid were all well preserved, and showed even less wear than most of the other oaks.

Turkey oak, zinc creosote.—Ten turkey oak ties treated at Beaumont by the zinc creosote process were overheated. These ties are considerably split, but they showed good wear and no signs of decay.

Turkey oak, Allardyce.—The 10 turkey oak ties treated by the Allardyce process at Somerville were found in excellent preservation, and showed very little wear.

Hemlock, untreated.—Of the 101 untreated hewn hemlock ties, 90 had fungi growing on the ends, in some cases to an unusual extent. Pl. II, fig. 1, gives a view of the ends of some of these hemlock ties. Two species of fungi are growing on them—one of the common brown pine fungus (*Lenzites sepiaria*), the other the gray fungus (*Polystictus versicolor* Fr.). The very high percentage of hemlock ties with fungi is a striking indication of the comparatively poor lasting power of this class of timber. For illustrating the preserving effect of treatment hemlock will be one of the most important woods.

Hemlock, Wellhouse.—The 100 hewn hemlock ties given the Wellhouse treatment at Chicago were in an excellent state of preservation, but showed considerable wear under the rail. It should be remembered that no tie-plates were used on these ties.

Hemlock, Allardyce.—The 50 hewn hemlock ties which were treated by the Allardyce process at Somerville were sound, but showed about as much wear as the untreated ties.

Hemlock, zinc creosote.—The general condition of the 49 hemlock ties treated by the zinc creosote process, with the use of English oil, at Beaumont, Tex., was good, but they showed wear to the depth of about half an inch.

Hemlock, Barschall.—Of the 100 hewn hemlock ties treated by the Barschall process, 32 ties had fungi—some a very few, others more. Four have the brown rot fungus (*Lenzites sepiaria*) and 28 a gray fungus (*Schizophyllum commune*). Most of these ties have worn well. (See Appendix, p. 41.)

Hemlock, Burnettized.—The 100 hewn hemlock ties treated with zinc chlorid at Chicago showed but little wear, and were perfectly sound.

Shortleaf pine, Burnettized.—There are 100 sawed 6 by 8 shortleaf pine ties which were treated at Somerville with zinc chlorid. These were all in good condition, and showed very little wear.

Shortleaf pine, zinc creosote.—All of the 50 sawed 6 by 8 shortleaf pine ties which were treated by the zinc creosote process were found in good condition, except that one had a bad check.

Shortleaf pine, Allardyce.—There are in addition 50 shortleaf pine ties sawed 6 by 8, which were treated by the Allardyce process at Somerville. These likewise were in an excellent condition. They showed very little wear.

Shortleaf pine, Barschall.—Ninety-eight sawed 6 by 8 shortleaf pine ties were treated by the Barschall process. Their general condition was good, except that they showed considerable wear—as much as half an inch in certain cases.

Shortleaf pine, Wellhouse.—The 100 sawed 6 by 8 shortleaf pine ties treated at Somerville by the Wellhouse process were in an excellent state of preservation, and showed a maximum wear of about a quarter of an inch.

Shortleaf pine, untreated.—In the case of the 100 sawed 6 by 8 untreated shortleaf pine ties, 31 had the brown fungus (*Lenzites sepiaria*) growing on the ends, chiefly on the sapwood. The ties had worn but little.

Longleaf pine, untreated.—Of the 93 untreated longleaf pine ties, 68 had the brown fungus (*Lenzites sepiaria*) growing on them, and some are very badly decayed. This is all the more surprising in view of the fact that the longleaf pine is supposed to be a more resistant timber than the other pines. The ties showed very little wear.

Longleaf pine, Wellhouse.—All of the 100 sawed longleaf pine ties treated at Somerville by the Wellhouse process were in excellent condition, and showed very little wear.

Longleaf pine, Barschall.—There are 100 longleaf pine ties treated by the Barschall process. All were in good condition, and showed very little wear.

Longleaf pine, Allardyce.—The 50 sawed 6 by 8 longleaf pine ties treated by the Allardyce process were generally in good condition.

Longleaf pine, zinc creosote.—There are 50 longleaf pine ties treated by the zinc creosote process which were overheated. One of these was badly broken, and others showed signs of giving out. This again is an instance of the weakening of the timber by excessive heat.

Longleaf pine, Burnettized.—The 100 sawed longleaf pine ties treated at Somerville with zinc chlorid were in excellent condition, and showed very little wear.

Longleaf pine, Beaumont oil.—There are 100 hewn longleaf pine ties which were soaked in Beaumont oil. They were in good condition, and had worn as much as, but no more than, the other longleaf ties.

Longleaf pine, zinc chlorid and Beaumont oil.—One hundred longleaf pine trees were treated with zinc chlorid and subsequently with Beaumont oil. They are in good condition, and show very little wear.

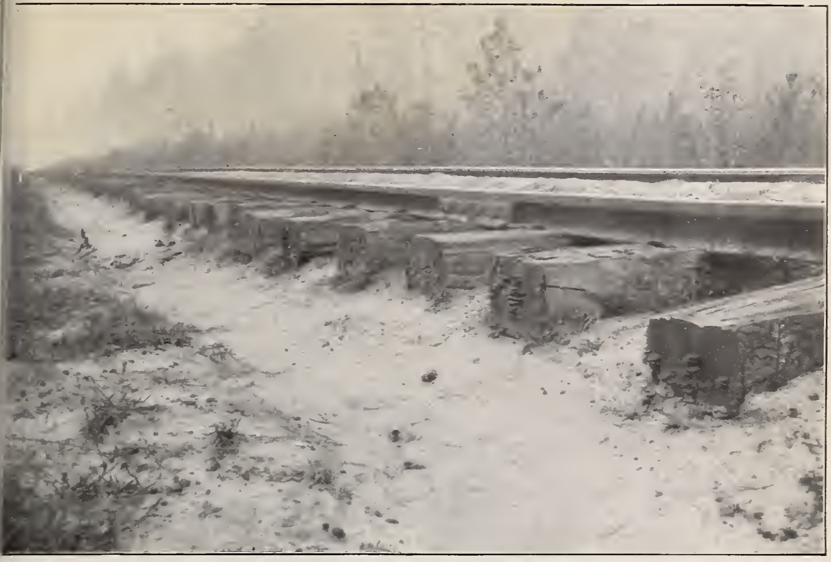

FIG. 1.—UNTREATED HEMLOCK TIES WITH A TIMBER-DESTROYING FUNGUS GROWING ON THEM.

[Note that almost all of these ties have fungi on them.]

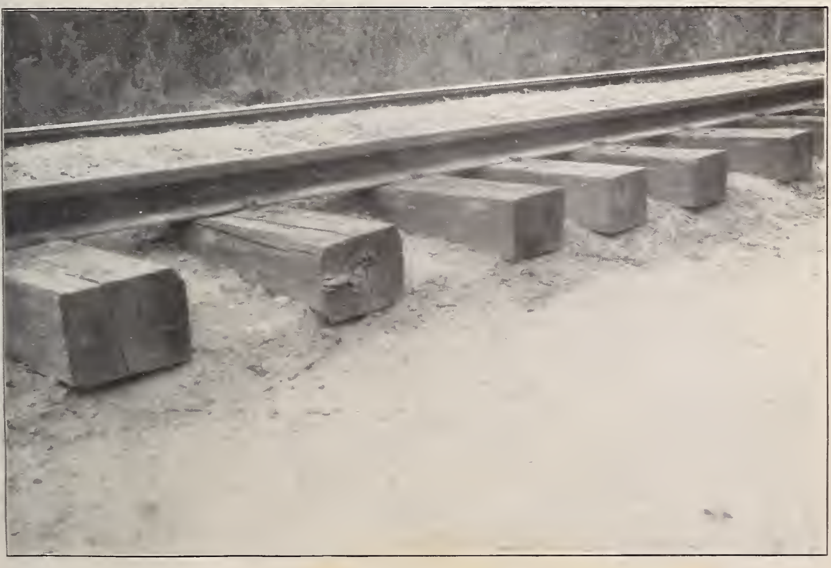

FIG. 2.—UNTREATED LONGLEAF PINE TIES, ONE OF WHICH SHOWS TIMBER-DESTROYING FUNGUS (LENZITES SEPIARIA).

Longleaf pine, spirittine.—The 100 longleaf pine ties treated with spirittine were all in excellent condition, and showed very little wear.

Loblolly pine, untreated.—Of the 100 loblolly pine ties untreated, 57 had large numbers of fruiting bodies of the brown fungus (*Lenzites sepiaria*) growing on the ends. The end of one of these ties is shown in fig. 1, Pl. III. The poor lasting qualities of the loblolly pine in this region are well known.

Loblolly pine, spirittine.—The 100 loblolly pine ties treated with spirittine were generally in good condition, but small fruiting organs of the gray fungus (*Schizophyllum commune*) were growing on three or four of them.

Loblolly pine, Beaumont oil. — There are 42 loblolly pine ties treated with Beaumont oil. On four of these the fruiting bodies of the brown fungus (*Lenzites sepiaria*) had appeared. The remainder were in excellent condition, and showed hardly any wear.

Loblolly pine, zinc chlorid and Beaumont oil.—Eighty ties were treated with zinc chlorid and subsequently with Beaumont oil. All of these were in excellent condition, and showed very little wear.

Loblolly pine, Burnettized.—All of the 100 loblolly pine ties treated with zinc chlorid at Somerville were in excellent condition, and showed wear not exceeding one-fourth of an inch.

Loblolly pine, Wellhouse.—The 100 loblolly pine ties treated at Somerville by the Wellhouse process were found in excellent condition, and showed no wear exceeding one-fourth of an inch.

Loblolly pine, Allardyce.—The 50 loblolly pine ties treated by the Allardyce process were in good condition, and showed little wear.

Loblolly pine, zinc creosote.—Fifty-one loblolly pine ties were treated by the zinc creosote process, using oil at a high temperature. There were no signs of decay, but many of the ties were badly worn.

Loblolly pine, Barschall.—The 99 loblolly pine ties treated by the Barschall process were generally in good condition, and showed no wear greater than a quarter of an inch. A few of them are somewhat checked. (See Appendix, p. 41.)

Redheart loblolly pine, Barschall.—There are 100 sawed loblolly pine ties, which were decidedly redhearted timber, treated by the Barschall process. These were found in an excellent state of preservation, but many of them had deep cuts under the rail and several were badly split. There was no sign, however, that the decay, which started in the tree before the tie was cut, was progressing.

Tamarack, Barschall.—On the ends of 5 of the 98 tamarack ties treated by the Barschall process fungi were growing. The ties showed a medium amount of wear, in some instances as much as half an inch, but their general condition was good. (See Appendix, p. 41.)

Tamarack, Allardyce.—There are 50 tamarack ties treated by the

Allardyce process. They showed no signs of decay, but were considerably worn.

Tamarack, zinc creosote.—There are 51 tamarack ties treated with zinc creosote. These are part of the lot which was badly burned during the treatment. They showed considerable wear, and many of them were badly split.

Tamarack, Burnettized.—All of the 49 tamarack ties treated at Chicago with zinc chlorid were in excellent condition, although some showed considerable wear.

Tamarack, Wellhouse.—The 100 tamarack ties which were treated by the Wellhouse process at Chicago were in an excellent state of preservation, and showed less wear than the other tamarack ties.

Tamarack, untreated.—Of the 49 untreated tamarack ties, 37 had the brown fungus (*Lenzites sepiaria*) growing on the ends. A large percentage were very badly decayed. It is probable that the majority of them will have to be taken out in the course of another year. Fig. 2, Pl. III, shows one of these tamarack ties which is almost wholly rotten.

Spanish oak, Barschall.—All of the 20 Spanish oak ties treated by the Barschall process were in excellent condition, with little indication of wear.

Spanish oak, Burnettized.—The 20 Spanish oak ties treated at Somerville with zinc chlorid were in excellent condition, and showed very little wear.

Spanish oak, Wellhouse.—There are 20 Spanish oak ties which were treated at Somerville by the Wellhouse process. All were in excellent condition, and showed very little wear.

Spanish oak, Allardyce.—The 10 Spanish oak ties treated by the Allardyce process at Somerville were in excellent condition, and showed little wear.

Spanish oak, zinc creosote.—There are 10 of these ties, which were part of the lot treated at a high temperature. Most of them are badly shattered and split. (See Appendix, pp. 42 and 43.)

Spanish oak, untreated.—Of the 20 untreated Spanish oak ties, 9 had fungi, which, however, do not seem to have injured the ties to any great extent. The wear is good.

Willow oak, Barschall.—The 20 willow oak ties treated by the Barschall process were in excellent condition.

Willow oak, untreated.—The 21 untreated willow oak ties were generally in excellent condition. One tie had a small fungus at one end.

Willow oak, Wellhouse.—All of the 20 willow oak ties treated at Somerville by the Wellhouse process were in excellent condition.

Willow oak, Allardyce.—The 10 willow oak ties treated by the Allardyce process at Somerville were in excellent condition.

Willow oak, zinc creosote.—There were 11 of these. They are part

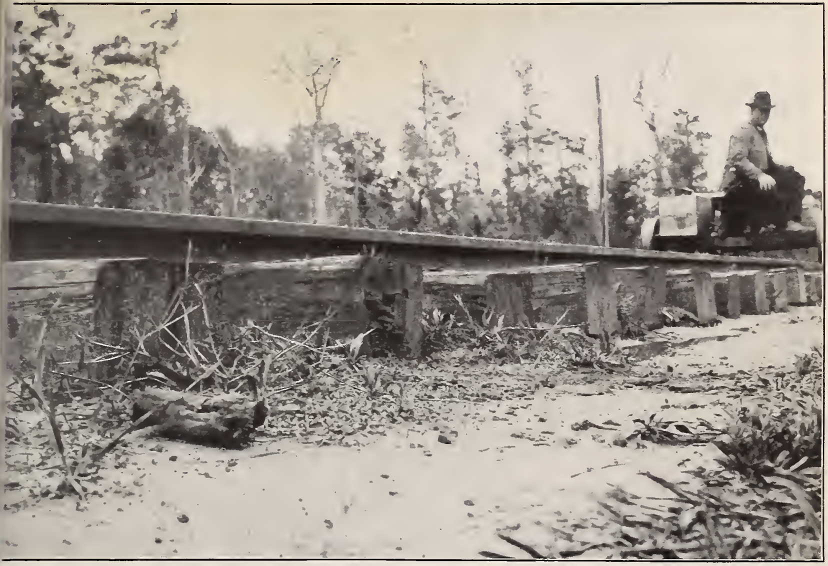

FIG. 1.—UNTREATED LOBLOLLY PINE TIES, SHOWING TIMBER-DESTROYING FUNGUS (LENZITES SEPIARIA) GROWING ON THE ENDS.

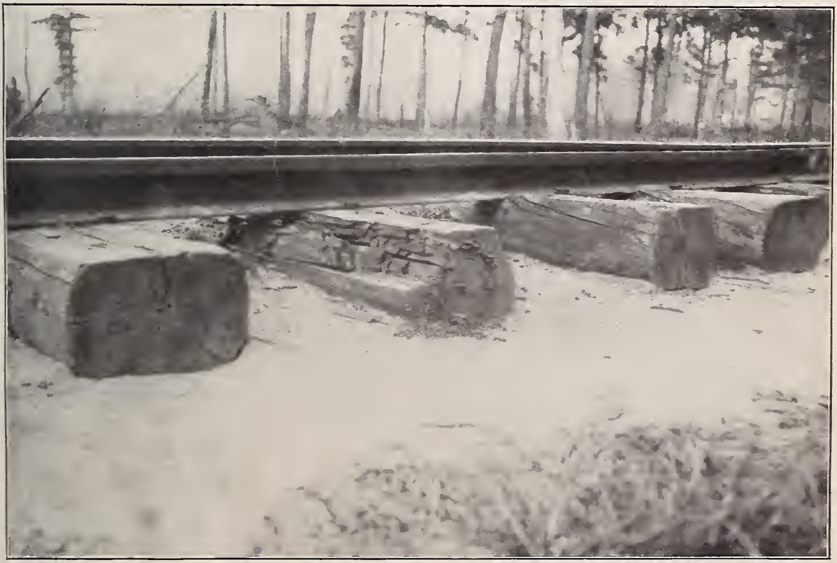

FIG. 2.—UNTREATED TAMARACK TIE BADLY DECAYED, SHOWING FRUITING BODIES OF TIMBER-DESTROYING FUNGUS.

of the lot which was overheated in treatment. Most of them are badly shattered, and will probably have to be removed before long. (See Appendix, pp. 43–44.)

Willow oak, Burnettized.—The 20 willow oak ties treated at Somerville with zinc chlorid were in excellent condition, and showed very little wear.

White oak, Burnettized.—There are 100 white oak ties which were treated with zinc chlorid at Somerville. All of these were in excellent condition, and showed very little wear or splitting.

White oak, Burnettized.—An additional 100 white oak ties, treated with zinc chlorid at Chicago, were also in excellent condition, and showed very little wear or splitting.

White oak, Allardyce.—There are 100 white oak ties which were treated by the Allardyce process at Somerville. Some of these are badly split, but none of them were decayed or badly worn under the rail.

White oak, zinc creosote.—Out of 107 of these ties, which were part of the lot excessively heated during treatment, 45 have been or are being removed, because they are so badly broken as to make the track unsafe. Those that are still in the track are badly shattered and broken, and most of them will be removed in the near future. In addition to the breaking, the rails have cut deeply into the wood. This lot of ties is certainly a striking illustration of what ought not to be done in treating timber. (See Appendix, pp. 42 and 43.)

White oak, untreated.—There are 196 untreated white oak ties. Twelve of these had a gray fungus on the ends (*Polystictus versicolor* Fr.) when inspected. Most of the ties were in a fair state of preservation.

White oak, Wellhouse.—All of the 100 ties of white oak treated at Somerville by the Wellhouse process at Chicago were in excellent condition, showing practically no wear.

White oak, Wellhouse.—The 100 white oak ties treated by the Wellhouse process at Chicago were in fine condition, showing no wear.

White oak, Barschall.—One hundred and ninety-six white oak ties treated by the Barschall process were laid, 7 of which have since been taken out to make room for a cattle guard. Those which remain showed very little wear, but 5 of them had fungi growing on the ends.

Black oak, Barschall.—There are 118 black oak ties which were treated by the Barschall process. Twenty-five had small fungi on the ends, and 3 of them were badly rotted at one end.

Black oak, Wellhouse.—The 13 black oak ties treated at Somerville by the Wellhouse process were in excellent condition, and showed little wear.

Black oak, Wellhouse.—The 86 black oak ties treated by the Wellhouse process at Chicago were in excellent condition, and showed little wear.

Black oak, Burnettized.—The 34 black oak ties treated at Somerville with zinc chlorid were in fine condition, and showed very little wear.

Black oak, Allardyce.—Most of the 60 black oak ties treated by the Allardyce process at Somerville are badly checked, but they showed very little wear.

Black oak, zinc creosote.—There were 76 black oak ties treated by the zinc creosote process and English oil which were part of the lot heated to a high temperature. Thirty-two of these have been removed, because they were so badly broken as to make traffic unsafe. They have been replaced with cypress ties. The remainder are badly split and shattered, and will be removed this year. (See Appendix, p. 42.)

Black oak, untreated.—The 25 untreated black oak ties showed no signs of decay, and very little wear.

Black oak, Wellhouse.—There are 20 black oak ties treated at Somerville by the Wellhouse process in addition to those previously mentioned, all of which were in excellent condition and showed no wear.

The number of ties, the kind of treatment, the mark assigned to each timber and each treatment, the place where the ties were treated, the order in which they were laid, and the number of ties on which fungi were found growing are indicated in the following table:

TABLE III.—*Condition of treated and untreated ties one and a half years in track.*

Kind of wood.	Number of ties.	Treatment.	Where treated.	Mark.	With fungi.
Beech	87	Untreated		B	38
Do	100	Wellhouse	Chicago	BWE*	
Do	99	Burnett	do	BBU*	
Do	98	Barschall	Somerville	BBA	20
Do	50	Allardyce	do	BAL	
Do	50	Zinc creosote (22 pounds English oil per cubic foot).	Beaumont	BAL**	
Red oak	20	Burnett	Somerville	ROBU	
Do	86	do	Chicago	ROBU*	
Do	93	Untreated		RO	16
Do	19	Barschall	Somerville	ROBA	
Do	20	Wellhouse	do	ROWE	
Do	10	Allardyce	do	ROAL	
Turkey oak	20	Untreated		YB	6
Do	20	Wellhouse	Somerville	YBWE	
Do	19	Barschall	do	YBBA	
Do	20	Burnett	do	YBBU	
Do	10	Zinc creosote (22 pounds English oil per cubic foot).	Beaumont	YBAL**	
Do	10	Allardyce	Somerville	YBAL	
Hemlock	101	Untreated		H	90
Do	100	Wellhouse	Chicago	HWE*	
Do	50	Allardyce	Somerville	HAL	
Do	49	Zinc creosote (22 pounds English oil per cubic foot).	Beaumont	HAL**	

TABLE III.—*Condition of treated and untreated ties, etc.*—Continued.

Kind of wood.	Number of ties.	Treatment.	Where treated.	Mark.	With fungi.
Hemlock	100	Barschall	Somerville	HBA	32
Do	100	Burnett	Chicago	HBU*	
Shortleaf pine	100	do	Somerville	SBU	
Do	50	Zinc creosote (22 pounds English oil per cubic foot).	Beaumont	SAL**	
Do	50	Allardyce	Somerville	SAL	
Do	98	Barschall	do	SBA	
Do	100	Wellhouse	do	SWE	
Do	100	Untreated		S	31
Longleaf pine	93	do		L	68
Do	100	Wellhouse	Somerville	LWE	
Do	100	Barschall	do	LBA	
Do	50	Allardyce	do	LAL	
Do	50	Zinc creosote (22 pounds English oil per cubic foot).	Beaumont	LAL**	
Do	100	Burnett	Somerville	LBU	
Do	100	Beaumont oil	do	LBO	
Do	100	Zinc chlorid; Beaumont oil	do	LBZ	
Do	100	Spirittine	do	LSP	
Loblolly pine	100	Untreated		LL	57
Do	100	Spirittine	Somerville	LLSP.	4
Do	42	Beaumont oil	do	LLBO	4
Do	80	Zinc chlorid; Beaumont oil	do	LLBZ	
Do	100	Burnett	do	LLBU	
Do	100	Wellhouse	do	LLWE	
Do	50	Allardyce	do	LLAL	
Do	51	Zinc creosote (22 pounds English oil per cubic foot).	Beaumont	LLAL**	
Do	99	Barschall	Somerville	LLBA	
Redheart pine	100	do	do	RHBA	
Tamarack	98	do	do	TBA	5
Do	50	Allardyce	do	TAL	
Do	51	Zinc creosote (22 pounds English oil per cubic foot).	Beaumont	TAL**	
Do	49	Burnett	Chicago	TBU*	
Do	100	Wellhouse	do	TWE*	
Do	49	Untreated		T	37
Spanish oak	20	Barschall	Somerville	SOBA	
Do	20	Burnett	do	SOBU	
Do	20	Wellhouse	do	SOWE	
Do	10	Allardyce	do	SOAL	
Do	10	Zinc creosote (22 pounds English oil per cubic foot).	Beaumont	SOAL**	
Do	20	Untreated	Somerville	SO	9
Willow oak	20	Barschall	do	WOBA	
Do	21	Untreated		WO	1
Do	20	Wellhouse	Somerville	WOWE	
Do	10	Allardyce	do	WOAL	
Do	11	Zinc creosote (22 pounds English oil per cubic foot).	Beaumont	WOAL**	
Do	20	Burnett	Somerville	WOBU	
White oak	100	do	do	WBU	
Do	100	do	Chicago	WBU*	
Do	100	Allardyce	Somerville	WAL	
Do	107	Zinc creosote (22 pounds English oil per cubic foot).	Beaumont	WAL**	
Do	196	Untreated		W	12

TABLE III.—*Condition of treated and untreated ties, etc.*—Continued.

Kind of wood.	Number of ties.	Treatment.	Where treated.	Mark.	With fungi.
White oak	100	Wellhouse	Somerville	WWE	
Do	100	do	Chicago	WWE*	
Do	196	Barschall	Somerville	WBA	5
Black oak	118	do	do	BOBA	25
Do	13	Wellhouse	do	BOWE	
Do	86	do	Chicago	BOWE*	
Do	34	Burnett	Somerville	BOBU	
Do	60	Allardyce	do	BOAL	
Do	76	Zinc creosote (22 pounds English oil per cubic foot).	Beaumont	BOAL**	
Do	25	Untreated		BO	
Do	20	Wellhouse	Somerville	BOWE	

NOTE.—The single and double stars (* and **) in the above list are the identification marks used to distinguish ties treated at the Chicago and Beaumont plants, respectively. Ties which bore neither mark were those treated at the Somerville plant.

GENERAL RESULT OF INSPECTION.

The experimental track had been in position for about nineteen months when the inspection herein recorded was made[a]. Although it is as yet rather early to draw any definite conclusions, a provisional summary of the result so far indicated may be made. It is thought well to mention that too much stress should not be laid on some of the results. When the track was laid it was foreseen that, owing to a number of matters beyond control of the Bureau of Plant Industry, it would not be possible to make the treatment an absolutely correct one. On page 31, Bulletin No. 14, Bureau of Plant Industry, published shortly after the track was laid, it was stated:

> While this experiment will without doubt yield some valuable results, the writer can not refrain from adding that it could be very much improved upon. The circumstances under which the experiment was made were of such a nature that many of the factors involved could not be controlled. * * * They [the timbers] were cut at different seasons and in different sections of the country. * * * It is only when this work is done on a large scale that absolutely trustworthy records will be obtained.

All who make timber treatment their business must recognize that the treatment of a few ties under conditions which were not such as would be used commercially can not justly be regarded as entirely fair to any one particular treatment. In spite of these defects in the experiment, the following results may be pointed out:

(1) Practically all of the untreated timbers show more or less decay. So far hemlock, tamarack, loblolly pine, and beech have

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[a] The beech ties were laid during February and March; the red oak ties during March and April; the turkey oak, hemlock, and shortleaf and longleaf pine ties during April; the loblolly pine ties during April and early May, and the tamarack, and Spanish, willow, white, and black oak ties during May, 1902.

shown the least resistance, closely followed by longleaf pine. The oaks show the greatest resistance.

(2) Ties which received the zinc chlorid and the Wellhouse treatments have so far shown no signs of decay. This is true also of those treated by the Allardyce process when it was carried on in a proper manner.

(3) The results shown by some of the oaks which were subjected to extreme heat and which had to be removed on account of brittleness should serve as a warning against excessive heating of the wood, whether with dry or with steam heat.

(4) Timbers which received the spirittine treatment are generally in good condition. The small fungi which were found growing on the ends of the ties were not considered as wood-destroying fungi. They have so far not affected the soundness of the timber.

(5) Of the timbers treated by the Barschall or Hasselmann process, the beech, hemlock, and tamarack have fungi growing on the ends. These timbers were treated in the second run, which, as stated by the report of the representative of the Barschall Company, found in the Appendix, did not give proper treatment. The oaks and pine treated by the Barschall process are so far sound.

(6) The results of the test clearly indicate that where timbers treated by various processes are to be compared they should be treated preferably in large quantities, and as nearly as possible under the usual conditions governing the treatment of timber for commercial purposes.

SECOND INSPECTION OF TRACK, JUNE 5, 1904.

On June 5, 1904, a second inspection of the experimental track was made by four officials of the Santa Fe Railway and one member of the Bureau, whose names are appended to the report. The place where the ties were treated can be ascertained from Table III.

TABLE IV.—*Condition of treated and untreated ties two years in track.*

Kind of wood.	Treatment.	Mark.	Consecutive numbers.	Condition.
Beech	Untreated	B	1 to 6	Fungus.
Do	do	B	7 and 8	Do.
Do	do	B	9	Good.
Do	do	B	10 to 20	Fungus.
Do	do	B	21	Good.
Do	do	B	22 to 27	Fungus.
Do	do	B	28	Fungus and rotten.
Do	do	B	29	Rotten.
Do	do	B	30	Fungus.
Do	do	B	31 to 33	Good.
Do	do	B	34 to 37	Fungus.
Do	do	B	38	Good.
Do	do	B	39 and 40	Fungus.
Do	do	B	41	Fungus and rotten.

TABLE IV.—*Condition of treated and untreated ties two years in track*—Cont'd.

Kind of wood.	Treatment.	Mark.	Consecutive numbers.	Condition.
Beech	Untreated	B	42 to 56	Fungus.
Do	do	B	47 and 48	Good.
Do	do	B	49 to 63	Fungus.
Do	do	B	64	Good.
Do	do	B	65	Fungus.
Do	do	B	66	Good.
Do	do	B	67	Fungus.
Do	do	B	68	Rotten.
Do	do	B	69	Fungus.
Do	do	B	70	Rotten.
Do	do	B	71 to 75	Fungus.
Do	do	B	76 to 78	Good.
Do	do	B	79	Fungus.
Do	do	B	80	Good.
Do	do	B	81 to 83	Fungus.
Do	do	B	84	Good.
Do	do	B	85 to 87	Fungus.
Do	Wellhouse	BWE*	1 to 100	Good.
Do	Burnett	BBU*	1 to 99	Do.
Do	Barschall	BBA	1 and 2	Fungus.
Do	do	BBA	3 and 4	Good.
Do	do	BBA	5	Broken center.
Do	do	BBA	6 and 7	Good.
Do	do	BBA	8	Rotten.
Do	do	BBA	9	Fungus.
Do	do	BBA	10	Rotten.
Do	do	BBA	11	Fungus.
Do	do	BBA	12	Good.
Do	do	BBA	13	Fungus.
Do	do	BBA	14 and 15	Good.
Do	do	BBA	16	Fungus.
Do	do	BBA	17	Good.
Do	do	BBA	18	Fungus.
Do	do	BBA	19 and 20	Good.
Do	do	BBA	21	Fungus.
Do	do	BBA	22 to 24	Good.
Do	do	BBA	25 and 26	Fungus.
Do	do	BBA	27 and 28	Good.
Do	do	BBA	29 and 30	Fungus.
Do	do	BBA	31	Good.
Do	do	BBA	32	Fungus.
Do	do	BBA	33 to 35	Good.
Do	do	BBA	36	Fungus.
Do	do	BBA	37	Good.
Do	do	BBA	38	Fungus.
Do	do	BBA	39	Good.
Do	do	BBA	40	Fungus.
Do	do	BBA	41 and 42	Good.
Do	do	BBA	43	Rotten.
Do	do	BBA	44	Fungus and split.
Do	do	BBA	45 to 47	Fungus.
Do	do	BBA	48	Good.
Do	do	BBA	49 and 50	Fungus.
Do	do	BBA	51	Good.
Do	do	BBA	52	Fungus.

TABLE IV.—*Condition of treated and untreated ties two years in track*—Cont'd.

Kind of wood.	Treatment.	Mark.	Consecutive numbers.	Condition.
Beech	Barschall	BBA	53	Good.
Do	do	BBA	54 and 55	Fungus and rotten.
Do	do	BBA	56 and 57	Good.
Do	do	BBA	58	Rotten.
Do	do	BBA	59	Good.
Do	do	BBA	60	Fungus and rotten.
Do	do	BBA	61	Rotten.
Do	do	BBA	62	Good.
Do	do	BBA	63 and 64	Fungus.
Do	do	BBA	65 and 66	Good.
Do	do	BBA	67	Do.
Do	do	BBA	68	Do.
Do	do	BBA	69 and 70	Replaced by cypress ties.
Do	do	BBA	71 to 75	Good.
Do	do	BBA	76 to 78	Fungus.
Do	do	BBA	79	Good.
Do	do	BBA	80	Fungus.
Do	do	BBA	81	Good.
Do	do	BBA	82	Split.
Do	do	BBA	83 and 84	Good.
Do	do	BBA	85	Fungus.
Do	do	BBA	86 to 88	Good.
Do	do	BBA	89	Fungus.
Do	do	BBA	90	Badly split.
Do	do	BBA	91 to 93	Good.
Do	do	BBA	94 to 97	Rotten.
Do	do	BBA	98	Good.
Do	Allardyce	BAL	1 to 50	Do.
Do	Zinc creosote (22 pounds English oil per cubic foot).	BAL**	1 to 41	Do.
Do	do	BAL**	42	Cracked.
Do	do	BAL**	43 to 50	Good.
Red oak	Burnett	ROBU	1 to 20	Do.
Do	do	ROBU*	1 to 80	Do.
Do	do	ROBU*	81	Rotten.
Do	do	ROBU*	82 to 86	Good.
Do	Untreated	RO	1 to 9	Do.
Do	do	RO	10	Fungus and split.
Do	do	RO	11	Good.
Do	do	RO	12 and 13	Rotten and fungus.
Do	do	RO	14	Fungus.
Do	do	RO	15	Rotten.
Do	do	RO	16 and 17	Good.
Do	do	RO	18	Split.
Do	do	RO	19	Rotten.
Do	do	RO	20 and 21	Split.
Do	do	RO	22	Good.
Do	do	RO	23	Rotten.
Do	do	RO	24 to 26	Rotten and split.
Do	do	RO	27	Fungus.
Do	do	RO	28	Split.
Do	do	RO	29	Good.
Do	do	RO	30	Fungus.
Do	do	RO	31	Rotten.

TABLE IV.—*Condition of treated and untreated ties two years in track*—Cont'd.

Kind of wood.	Treatment.	Mark.	Consecutive numbers.	Condition.
Red oak	Untreated	RO	32	Fungus.
Do	do	RO	33 and 34	Split.
Do	do	RO	35	Fungus.
Do	do	RO	36	Fungus and split.
Do	do	RO	37	Rotten.
Do	do	RO	38	Rotten and split.
Do	do	RO	39	Fungus.
Do	do	RO	40 to 48	Split.
Do	do	RO	45 and 46	Do.
Do	do	RO	47 and 48	Split and fungus.
Do	do	RO	49	Fungus.
Do	do	RO	50	Badly split.
Do	do	RO	51	Rotten.
Do	do	RO	52	Rotten and split.
Do	do	RO	53	Fungus.
Do	do	RO	54	Rotten.
Do	do	RO	55	Split.
Do	do	RO	56 to 58	Fungus and rotten.
Do	do	RO	59	Split.
Do	do	RO	60 and 61	Fungus.
Do	do	RO	62	Good.
Do	do	RO	63	Fungus and split.
Do	do	RO	64	Rotten.
Do	do	RO	65	Split.
Do	do	RO	66	Good.
Do	do	RO	67 to 71	Replaced by cypress ties.
Do	do	RO	72 to 93	Fair.
Do	Barschall	ROBA	1 to 19	Good.
Do	Wellhouse	ROWE	1 to 20	Do.
Do	Allardyce	ROAL	1 to 10	Do.
Turkey oak	Untreated	YB	1 to 20	Do.
Do	Wellhouse	YBWE	1 to 20	Do.
Do	Barschall	YBBA	1 to 19	Do.
Do	Burnett	YBBU	1 to 20	Fair.
Do	Zinc creosote (22 pounds English oil per cubic foot).	YBAL**	1 to 10	Fair. Damaged in treatment.
Do	Allardyce	YBAL	1 to 10	Fair.
Hemlock	Untreated	H	1 to 101	All fungus and rotten. Must all come out at once.
Do	Wellhouse	HWE*	1 to 100	Weather-cracked.
Do	Allardyce	HAL	1 to 50	Do.
Do	Zinc creosote (22 pounds English oil per cubic foot).	HAL**	1 to 49	Rail-cut and weather-cracked.
Do	Barschall	HBA	1	Fungus.
Do	do	HBA	2	Good.
Do	do	HBA	3 and 4	Fungus.
Do	do	HBA	5	Good.
Do	do	HBA	6 to 8	Fungus.
Do	do	HBA	9 to 11	Good.
Do	do	HBA	12	Fungus.
Do	do	HBA	13	Good.
Do	do	HBA	14 to 17	Fungus.
Do	do	HBA	18	Good.
Do	do	HBA	19	Fungus.

TABLE IV.—*Condition of treated and untreated ties two years in track*—Cont'd.

Kind of wood.	Treatment.	Mark.	Consecutive numbers.	Condition.
Hemlock	Barschall	HBA	20	Good.
Do	do	HBA	21 and 22	Fungus.
Do	do	HBA	23	Good.
Do	do	HBA	24	Fungus.
Do	do	HBA	25	Good.
Do	do	HBA	26 to 30	Fungus.
Do	do	HBA	31 to 33	Good.
Do	do	HBA	34	Fungus.
Do	do	HBA	35 to 38	Good.
Do	do	HBA	39 to 43	Fungus.
Do	do	HBA	44	Good.
Do	do	HBA	45 to 50	Fungus.
Do	do	HBA	51	Good.
Do	do	HBA	52	Fungus.
Do	do	HBA	53 and 54	Good.
Do	do	HBA	55	Fungus.
Do	do	HBA	56 and 57	Good.
Do	do	HBA	58 and 59	Fungus.
Do	do	HBA	60	Good.
Do	do	HBA	61 and 62	Fungus.
Do	do	HBA	63	Good.
Do	do	HBA	64 and 65	Fungus.
Do	do	HBA	66	Good.
Do	do	HBA	67	Fungus.
Do	do	HBA	68 to 71	Good.
Do	do	HBA	72 to 77	Fungus.
Do	do	HBA	78	Good.
Do	do	HBA	79 to 97	Fungus.
Do	do	HBA	98 to 100	Good.
Do	Burnett	HBU*	1 to 100	Do.
Shortleaf pine	do	SBU	1 to 100	Do.
Do	Zinc creosote (22 pounds English oil per cubic foot).	SAL**	1 to 50	Do.
Do	Allardyce	SAL	1 to 50	Do.
Do	Barschall	SBA	1 to 68	Do.
Do	do	SBA	69	Rotten.
Do	do	SBA	70 to 98	Good.
Do	Wellhouse	SWE	1 to 49	Do.
Do	do	SWE	50	Rotten.
Do	do	SWE	51 to 100	Good.
Do	Untreated	S	1 to 6	Do.
Do	do	S	7 to 12	Fungus.
Do	do	S	13 to 19	Good.
Do	do	S	20 to 22	Fungus.
Do	do	S	23	Rotten.
Do	do	S	24	Fungus.
Do	do	S	25 and 26	Good.
Do	do	S	27 to 29	Fungus.
Do	do	S	30 to 35	Good.
Do	do	S	36 to 40	Fungus.
Do	do	S	41 and 42	Good.
Do	do	S	43 to 45	Fungus.
Do	do	S	46 and 47	Good.
Do	do	S	48 to 52	Fungus.
Do	do	S	53	Good.

TABLE IV.—*Condition of treated and untreated ties two years in track*—Cont'd.

Kind of wood	Treatment.	Mark.	Consecutive numbers.	Condition.
Shortleaf pine	Untreated	S	54 and 55	Fungus.
Do	do	S	56	Good.
Do	do	S	57	Fungus.
Do	do	S	58 and 59	Good.
Do	do	S	60 and 61	Fungus.
Do	do	S	62	Good.
Do	do	S	63 to 65	Fungus.
Do	do	S	66 and 67	Good.
Do	do	S	68 and 69	Fungus.
Do	do	S	70 to 72	Good.
Do	do	S	73	Fungus.
Do	do	S	74 and 75	Good.
Do	do	S	76 and 77	Fungus.
Do	do	S	78 and 79	Good.
Do	do	S	80	Fungus.
Do	do	S	81 and 82	Good.
Do	do	S	83	Fungus.
Do	do	S	84	Good.
Do	do	S	85 and 86	Fungus.
Do	do	S	87 and 88	Good.
Do	do	S	89	Fungus.
Do	do	S	90 to 92	Good.
Do	do	S	93 and 94	Fungus.
Do	do	S	95 and 96	Good.
Do	do	S	97	Fungus.
Do	do	S	98 and 99	Good.
Do	do	S	100	Fungus.
Longleaf pine	do	L	1	Do.
Do	do	L	2 to 21	Good.
Do	do	L	22	Fungus.
Do	do	L	23 and 24	Rotten and fungus.
Do	do	L	25	Fungus.
Do	do	L	26	Rotten and fungus.
Do	do	L	27 and 28	Fungus.
Do	do	L	29	Rotten and fungus.
Do	do	L	30 to 36	Fungus.
Do	do	L	37	Good.
Do	do	L	38	Rotten and fungus.
Do	do	L	39 to 45	Fungus.
Do	do	L	46	Good.
Do	do	L	47	Fungus.
Do	do	L	48	Rotten and fungus.
Do	do	L	49 to 56	Fungus.
Do	do	L	57 to 59	Rotten.
Do	do	L	60 to 67	Fungus.
Do	do	L	68	Rotten and fungus.
Do	do	L	69 to 72	Fungus.
Do	do	L	73	Rotten.
Do	do	L	74	Fungus.
Do	do	L	75	Good.
Do	do	L	76	Do.
Do	do	L	77 to 82	Fungus.
Do	do	L	83 and 84	Rotten and fungus.
Do	do	L	85 to 93	Fungus.
Do	Wellhouse	LWE	1 to 100	Good.

TABLE IV.—*Condition of treated and untreated ties two years in track*—Cont'd.

Kind of wood.	Treatment.	Mark.	Consecutive numbers.	Condition.
Longleaf pine	Barschall	LBA	1 to 100	Good.
Do	Allardyce	LAL	1 to 50	Do.
Do	Zinc creosote (22 pounds English oil per cubic foot).	LAL**	1 to 50	Good. Slightly rail-cut.
Do	Burnett	LBU	1 to 100	Good.
Do	Beaumont oil	LBO	1 to 28	Fair.
Do	do	LBO	29	Rotten.
Do	do	LBO	30 to 41	Good.
Do	do	LBO	42	Split.
Do	do	LBO	43 to 45	Good.
Do	do	LBO	46	Fungus.
Do	do	LBO	47 to 100	Fair.
Do	Zinc chlorid; Beaumont oil.	LBZ	1 to 100	Good.
Do	Spirittine	SPL	All but 2 of the 100.	Do.
Loblolly pine	Untreated		1 to 100	All removed spring of 1904 account rot.
Do	Spirittine	LLSP	1	Do.
Do	do	LLSP	2 to 4	Fungus.
Do	do	LLSP	5 to 12	Good.
Do	do	LLSP	13	Fungus.
Do	do	LLSP	14 to 23	Good.
Do	do	LLSP	24	Fungus.
Do	do	LLSP	25	Good.
Do	do	LLSP	26	Fungus.
Do	do	LLSP	27 to 30	Good.
Do	do	LLSP	31	Fungus.
Do	do	LLSP	32 to 34	Good.
Do	do	LLSP	35	Fungus.
Do	do	LLSP	36	Good.
Do	do	LLSP	37	Fungus.
Do	do	LLSP	38 to 40	Good.
Do	do	LLSP	41	Fungus.
Do	do	LLSP	42	Rotten.
Do	do	LLSP	45 and 46	Fungus.
Do	do	LLSP	47	Good.
Do	do	LLSP	48	Fungus.
Do	do	LLSP	49 to 51	Good.
Do	do	LLSP	52	Fungus.
Do	do	LLSP	53 to 56	Good.
Do	do	LLSP	57	Fungus.
Do	do	LLSP	58	Do.
Do	do	LLSP	59 and 60	Good.
Do	do	LLSP	61	Fungus.
Do	do	LLSP	62 to 65	Good.
Do	do	LLSP	66	Fungus.
Do	do	LLSP	67 to 76	Good.
Do	do	LLSP	77	Fungus.
Do	do	LLSP	78 to 84	Good.
Do	do	LLSP	85	Fungus.
Do	do	LLSP	86 and 87	Good.
Do	do	LLSP	88 to 90	Fungus.
Do	do	LLSP	91 to 100	Good.
Do	Beaumont oil	LLBO	1	Do.
Do	do	LLBO	2	Rotten.

TABLE IV.—*Condition of treated and untreated ties two years in track*—Cont'd.

Kind of wood.	Treatment.	Mark.	Consecutive numbers.	Condition.
Loblolly pine	Beaumont oil	LLBO	3 to 6	Good.
Do	do	LLBO	7	Split.
Do	do	LLBO	8 to 12	Good.
Do	do	LLBO	13 and 14	Fungus.
Do	do	LLBO	15 to 22	Good.
Do	do	LLBO	23	Fungus and rotten.
Do	do	LLBO	24 to 26	Good.
Do	do	LLBO	27	Rotten.
Do	do	LLBO	28 and 29	Good.
Do	do	LLBO	30	Fungus and rotten.
Do	do	LLBO	31	Good.
Do	do	LLBO	32	Fungus.
Do	do	LLBO	33	Good.
Do	do	LLBO	34	Fungus.
Do	do	LLBO	35	Good.
Do	do	LLBO	36 and 37	Fungus.
Do	do	LLBO	38	Good.
Do	do	LLBO	39	Fungus.
Do	do	LLBO	40 to 42	Good.
Do	Zinc chlorid; Beaumont oil.	LLBZ	1 to 52	Fair.
Do	do	LLBZ	53 to 58	Do.
Do	do	LLBZ	59	Split.
Do	do	LLBZ	60 to 80	Fair.
Do	Burnett	LLBU	1 to 100	Do.
Do	Wellhouse	LLWE	1 to 74	Do.
Do	do	LLWE	75	Badly split.
Do	do	LLWE	76 to 100	Fair.
Do	Allardyce	LLAL	1 to 50	Do.
Do	Zinc creosote (22 pounds English oil per cubic foot).	LLAL**	1 to 51	Fair; rail-cut.
Do	Barschall	LLBA	1 to 99	Good.
Red heart pine	do	RHBA	1 to 21	Fair.
Do	do	RHBA	22	Rotten.
Do	do	RHBA	23 to 25	Fair.
Do	do	RHBA	26	Rotten.
Do	do	RHBA	27 to 41	Fair.
Do	do	RHBA	42	Rotten.
Do	do	RHBA	43 to 84	Fair.
Do	do	RHBA	85	Rotten.
Do	do	RHBA	86 to 100	Fair.
Tamarack	do	TBA	1 to 16	Good.
Do	do	TBA	17	Fungus.
Do	do	TBA	18	Good.
Do	do	TBA	19	Fungus.
Do	do	TBA	20 to 24	Fair.
Do	do	TBA	25	Fungus.
Do	do	TBA	26 and 27	Fair.
Do	do	TBA	28	Fungus.
Do	do	TBA	29	Do.
Do	do	TBA	30	Fair.
Do	do	TBA	31	Fungus.
Do	do	TBA	32 to 43	Fair.
Do	do	TBA	44	Fungus.
Do	do	TBA	45	Fair.

TABLE IV.—*Condition of treated and untreated ties two years in track*—Cont'd.

Kind of wood.	Treatment.	Mark.	Consecutive numbers.	Condition.
Tamarack	Barschall	TBA	46	Fungus.
Do	do	TBA	47	Fair.
Do	do	TBA	48	Fungus.
Do	do	TBA	49	Fungus and rotten.
Do	do	TBA	50 to 56	Fair.
Do	do	TBA	57	Fungus.
Do	do	TBA	58	Fair.
Do	do	TBA	59	Fungus.
Do	do	TBA	60 to 65	Fair.
Do	do	TBA	66	Fungus.
Do	do	TBA	67 to 70	Fair.
Do	do	TBA	71	Fungus.
Do	do	TBA	72 to 76	Fair.
Do	do	TBA	77 and 78	Fungus.
Do	do	TBA	79 and 80	Fair.
Do	do	TBA	81 to 84	Fungus.
Do	do	TBA	85 to 98	Fair.
Do	Allardyce	TAL	1 to 50	Do.
Do	Zinc creosote (22 pounds English oil per cubic foot).	TAL**	1 to 43	Fair; rail-cut.
Do	do	TAL**	44	Burnt in treatment.
Do	do	TAL**	45 to 51	Rail-cut.
Do	Burnett	TBU*	1 to 49	Fair.
Do	Wellhouse	TWE*	1 to 100	Good.
Do	Untreated	T	1	Fungus and rotten.
Do	do	T	2	Rotten.
Do	do	T	3	Good.
Do	do	T	4 and 5	Fungus and rotten.
Do	do	T	6	Good.
Do	do	T	7	Fungus and rotten.
Do	do	T	8 to 11	Fungus.
Do	do	T	12	Good.
Do	do	T	13 and 14	Fungus and rotten.
Do	do	T	15 to 18	Fungus.
Do	do	T	19	Good.
Do	do	T	20 and 21	Fungus.
Do	do	T	22 and 23	Good.
Do	do	T	24 to 26	Fungus and rotten.
Do	do	T	27 to 32	Fungus.
Do	do	T	33	Good.
Do	do	T	34 to 40	Fungus.
Do	do	T	41	Good.
Do	do	T	42 to 49	Fungus.
Spanish oak	Barschall	SOBA	1 to 20	Good.
Do	Burnett	SOBU	1 to 20	Do.
Do	Wellhouse	SOWE	1 to 20	Do.
Do	Allardyce	SOAL	1 to 10	Good.
Do	Zinc creosote (22 pounds English oil per cubic foot).	SOAL**	1 to 3	Split; burnt in treatment.
Do	do	SOAL**	4 and 5	Rail-cut.
Do	do	SOAL**	6	Burnt in treatment.
Do	do	SOAL**	7 and 8	Good.
Do	do	SOAL**	9 and 10	Burnt in treatment.
Do	Untreated	SO	1 to 3	Fungus.

TABLE IV.—*Condition of treated and untreated ties two years in track*—Cont'd.

Kind of wood.	Treatment.	Mark.	Consecutive numbers.	Condition.
Spanish oak	Untreated	SO	4	Good.
Do	do	SO	5 and 6	Fungus.
Do	do	SO	7	Good.
Do	do	SO	8 and 9	Fungus.
Do	do	SO	10	Good.
Do	do	SO	11	Fungus.
Do	do	SO	12 and 13	Good.
Do	do	SO	14 and 15	Fungus.
Do	do	SO	16	Good.
Do	do	SO	17 and 18	Fungus.
Do	do	SO	19	Good.
Do	do	SO	20	Fungus.
Willow oak	Barschall	WOBA	1 to 15	Good.
Do	do	WOBA	16	Split.
Do	do	WOBA	17 to 20	Good.
Do	Untreated	WO	1 to 6	Do.
Do	do	WO	7	Split.
Do	do	WO	8 to 16	Good.
Do	do	WO	17	Split.
Do	do	WO	18 to 20	Good.
Do	Wellhouse	WOWE	1 to 20	Do.
Do	Allardyce	WOAL	1 to 10	Fair.
Do	Zinc creosote (22 pounds English oil per cubic foot.)	WOAL**	1	Rotten and broken center.
Do	do	WOAL**	2 to 5	Good.
Do	do	WOAL**	6 to 11	Destroyed in treatment.
Do	Burnett	WOBU	1 to 20	Good.
White oak	do	WBU	1 to 24	Do.
Do	do	WBU	25	Cracked.
Do	do	WBU	26 to 33	Good
Do	do	WBU	34	Cracked.
Do	do	WBU	35 to 38	Good.
Do	do	WBU	39	Cracked.
Do	do	WBU	40 to 46	Good.
Do	do	WBU	47	Cracked.
Do	do	WBU	48 to 54	Good.
Do	do	WBU	55	Cracked.
Do	do	WBU	56 to 61	Good.
Do	do	WBU	62	Cracked.
Do	do	WBU	63 to 69	Good.
Do	do	WBU	70 and 71	Cracked.
Do	do	WBU	72 to 85	Good.
Do	do	WBU	86	Cracked.
Do	do	WBU	87 to 97	Good.
Do	do	WBU	98	Cracked.
Do	do	WBU	99 and 100	Good.
Do	do	WBU*	1 to 41	Do.
Do	do	WBU*	42	Cracked.
Do	do	WBU*	43 to 100	Good.
Do	Allardyce	WAL	1 to 60	Do.
Do	do	WAL	61	Cracked.
Do	do	WAL	62 to 84	Good.
Do	do	WAL	85 and 86	Badly cracked.
Do	do	WAL	87 to 100	Good.

TABLE IV.—*Condition of treated and untreated ties two years in track*—Cont'd.

Kind of wood.	Treatment.	Mark.	Consecutive numbers.	Condition.
White oak	Zinc creosote (22 pounds English oil per cubic foot).	WAL**	1 to 53	Replaced by cypress ties.
Do	do	WAL**	54 and 55	Replaced by pine ties.
Do	do	WAL**	56	Replaced by cypress tie.
Do	do	WAL**	57 to 63	Replaced by pine ties.
Do	do	WAL**	64 to 67	Unserviceable.
Do	do	WAL**	68	Replaced by cypress tie.
Do	do	WAL**	69 and 70	Unserviceable.
Do	do	WAL**	71	Replaced by cypress tie.
Do	do	WAL**	72	Unserviceable.
Do	do	WAL**	73	Replaced by cypress tie.
Do	do	WAL**	74	Unserviceable.
Do	do	WAL**	75	Replaced by cypress tie.
Do	do	WAL**	76 and 77	Unserviceable.
Do	do	WAL**	78 and 79	Replaced by cypress ties.
Do	do	WAL**	80	Unserviceable.
Do	do	WAL**	81	Replaced by cypress tie.
Do	do	WAL**	82	Unserviceable.
Do	do	WAL**	83	Replaced by cypress tie.
Do	do	WAL**	84	Unserviceable.
Do	do	WAL**	85	Replaced by cypress tie.
Do	do	WAL**	86	Unserviceable.
Do	do	WAL**	87	Replaced by cypress tie.
Do	do	WAL**	88	Unserviceable.
Do	do	WAL**	89 to 94	Replaced by cypress ties.
Do	do	WAL**	95 to 97	Unserviceable.
Do	do	WAL**	98 and 99	Replaced by cypress ties.
Do	do	WAL**	100 to 107	Unserviceable.
Do	Untreated	W	1 to 9	Good.
Do	do	W	10	Sap-rot.
Do	do	W	11 to 71	Good.
Do	do	W	72	Rotten.
Do	do	W	73 to 80	Good.
Do	do	W	81	Heart shaken.
Do	do	W	82 to 100	Good
Do	do	W	101 and 102	Fungus.
Do	do	W	103	Good.
Do	do	W	104	Fungus.
Do	do	W	105 to 121	Good.
Do	do	W	122	Fungus.
Do	do	W	123	Good.
Do	do	W	124	Fungus.
Do	do	W	125	Good.
Do	do	W	126	Fungus.
Do	do	W	127 to 153	Good.

TABLE IV.—*Condition of treated and untreated ties two years in track*—Cont'd.

Kind of wood.	Treatment	Mark.	Consecutive numbers.	Condition.
White oak	Untreated	W	154	Fungus.
Do	do	W	155 to 158	Good.
Do	do	W	159	Fungus.
Do	do	W	160 to 170	Good.
Do	do	W	171	Fungus.
Do	do	W	172	Good.
Do	do	W	173	Fungus.
Do	do	W	174 and 175	Good.
Do	do	W	176	Badly split.
Do	do	W	177 to 183	Good.
Do	do	W	184	Fungus.
Do	do	W	185 to 188	Good.
Do	do	W	189	Sap-rot.
Do	do	W	190 to 192	Good.
Do	do	W	193	Sap-rot.
Do	do	W	194	Fungus and split.
Do	do	W	195	Good.
Do	do	W	196	Replaced by cypress tie.
Do	Wellhouse	WWE	1 to 74	Good.
Do	do	WWE	75	Badly cracked.
Do	do	WWE	76 to 100	Good.
Do	do	WWE*	1 to 90	Do.
Do	do	WWE*	91	Cracked.
Do	do	WWE*	92 to 100	Good.
Do	Barschall	WBA	1 to 29	Do.
Do	do	WBA	30	Split.
Do	do	WBA	31 to 38	Good.
Do	do	WBA	39	Shattered.
Do	do	WBA	40 to 56	Good.
Do	do	WBA	57	Cracked.
Do	do	WBA	58 to 79	Good.
Do	do	WBA	80	Rotten.
Do	do	WBA	81 to 88	Good.
Do	do	WBA	89	Cracked.
Do	do	WBA	90 to 108	Good.
Do	do	WBA	109	Rotten.
Do	do	WBA	110	Fungus.
Do	do	WBA	111	Good.
Do	do	WBA	112	Cracked.
Do	do	WBA	113 to 123	Good.
Do	do	WBA	124 and 125	Cracked.
Do	do	WBA	126 to 146	Good.
Do	do	WBA	147	Cracked.
Do	do	WBA	148 to 161	Good.
Do	do	WBA	162	Cracked.
Do	do	WBA	163 to 196	Good.
Black oak	do	BOBA	1 to 3	Fungus.
Do	do	BOBA	4	Good.
Do	do	BOBA	5 and 6	Cracked.
Do	do	BOBA	7	Good.
Do	do	BOBA	8	Fungus.
Do	do	BOBA	9 to 13	Good.
Do	do	BOBA	14	Rotten.
Do	do	BOBA	15	Cracked.
Do	do	BOBA	16 and 17	Good.

TABLE IV.—*Condition of treated and untreated ties two years in track*—Cont'd.

Kind of wood.	Treatment.	Mark.	Consecutive numbers.	Condition.
Black oak	Barschall	BOBA	18	Cracked.
Do	do	BOBA	19 and 20	Good.
Do	do	BOBA	21	Cracked.
Do	do	BOBA	22	Good.
Do	do	BOBA	23 and 24	Fungus.
Do	do	BOBA	25	Fungus and cracked.
Do	do	BOBA	26	Good.
Do	do	BOBA	27	Cracked.
Do	do	BOBA	28 to 30	Good.
Do	do	BOBA	31	Fungus and rotten.
Do	do	BOBA	32 and 33	Cracked.
Do	do	BOBA	34	Rotten.
Do	do	BOBA	35	Cracked.
Do	do	BOBA	36 and 37	Good.
Do	do	BOBA	38	Rotten.
Do	do	BOBA	39	Good.
Do	do	BOBA	40	Rotten.
Do	do	BOBA	41	Good.
Do	do	BOBA	42	Rotten.
Do	do	BOBA	43	Good.
Do	do	BOBA	44	Cracked.
Do	do	BOBA	45	Rotten.
Do	do	BOBA	46	Rotten and broken center.
Do	do	BOBA	47	Good.
Do	do	BOBA	48 to 55	Rotten.
Do	do	BOBA	56	Cracked.
Do	do	BOBA	57	Good.
Do	do	BOBA	58 and 59	Cracked.
Do	do	BOBA	60 to 64	Good.
Do	do	BOBA	65	Rotten.
Do	do	BOBA	66	Cracked.
Do	do	BOBA	67 and 68	Good.
Do	do	BOBA	69	Rotten.
Do	do	BOBA	70 and 71	Good.
Do	do	BOBA	72	Rotten.
Do	do	BOBA	73	Cracked.
Do	do	BOBA	74 and 75	Good.
Do	do	BOBA	76	Rotten.
Do	do	BOBA	77	Good.
Do	do	BOBA	78	Rotten and cracked.
Do	do	BOBA	79	Rotten.
Do	do	BOBA	80 and 81	Good.
Do	do	BOBA	82	Fungus.
Do	do	BOBA	83 to 85	Rotten.
Do	do	BOBA	86 to 88	Good.
Do	do	BOBA	89	Rotten.
Do	do	BOBA	90	Good.
Do	do	BOBA	91	Badly cracked.
Do	do	BOBA	92 to 94	Good.
Do	do	BOBA	95	Cracked.
Do	do	BOBA	96 to 98	Rotten.
Do	do	BOBA	99 to 111	Good.
Do	do	BOBA	112	Rotten.
Do	do	BOBA	113 to 118	Good.

TABLE IV.—*Condition of treated and untreated ties two years in track*—Cont'd.

Kind of wood.	Treatment.	Mark.	Consecutive numbers.	Condition.
Black oak	Wellhouse	BOWE	1 to 13	Good.
Do	do	BOWE*	1 to 12	Do.
Do	do	BOWE*	13	Badly cracked.
Do	do	BOWE*	14	Good.
Do	do	BOWE*	15 to 17	Badly cracked.
Do	do	BOWE*	18 to 23	Good.
Do	do	BOWE*	24	Cracked.
Do	do	BOWE*	25	Do.
Do	do	BOWE*	26 to 32	Good.
Do	do	BOWE*	33	Cracked.
Do	do	BOWE*	34 to 40	Good.
Do	do	BOWE*	41	Badly cracked.
Do	do	BOWE*	42 to 56	Good.
Do	do	BOWE*	57	Cracked.
Do	do	BOWE*	58	Good.
Do	do	BOWE*	59	Do.
Do	do	BOWE*	60	Badly cracked.
Do	do	BOWE*	61	Good.
Do	do	BOWE*	62 to 66	Badly cracked.
Do	do	BOWE*	67 to 86	Good.
Do	Burnett	BOBU	1 to 18	Do.
Do	do	BOBU	19	Heart shaken.
Do	do	BOBU	20 to 24	Good.
Do	do	BOBU	25 to 27	Badly cracked.
Do	do	BOBU	28 to 34	Good.
Do	Allardyce	BOAL	1 to 18	Do.
Do	do	BOAL	19	Cracked.
Do	do	BOAL	20 to 25	Good.
Do	do	BOAL	26	Badly cracked.
Do	do	BOAL	27 to 34	Good.
Do	do	BOAL	35	Badly cracked.
Do	do	BOAL	36	Good.
Do	do	BOAL	37	Badly cracked.
Do	do	BOAL	38 to 45	Good.
Do	do	BOAL	46	Badly cracked.
Do	do	BOAL	47 to 57	Good.
Do	do	BOAL	58	Badly cracked.
Do	do	BOAL	59	Good.
Do	do	BOAL	60	Do.
Do	Zinc creosote (22 pounds English oil per cubic foot).	BOAL**	1	Replaced by cypress tie.
Do	do	BOAL**	2	Badly cracked.
Do	do	BOAL**	3 to 5	Rotten.
Do	do	BOAL**	6	Replaced by cypress tie.
Do	do	BOAL**	7	Badly cracked.
Do	do	BOAL**	8	Replaced by cypress tie.
Do	do	BOAL**	9	Rail-cut 1 inch.
Do	do	BOAL**	10	Replaced by cypress tie.
Do	do	BOAL**	11 to 13	Rail-cut.
Do	do	BOAL**	14	Rotten and broken.
Do	do	BOAL**	15	Rail-cut.
Do	do	BOAL**	16 to 26	Replaced by cypress ties.

TABLE IV.—*Condition of treated and untreated ties two years in track*—Cont'd.

Kind of wood.	Treatment.	Mark.	Consecutive numbers.	Condition.
Black oak	Zinc creosote (22 pounds English oil per cubic foot).	BOAL**	27 and 28	Rotten.
Do	do	BOAL**	29	Replaced by cypress tie.
Do	do	BOAL**	30	Cracked.
Do	do	BOAL**	31 and 32	Replaced by cypress ties.
Do	do	BOAL**	33	Rail-cut and cracked.
Do	do	BOAL**	34	Replaced by cypress tie.
Do	do	BOAL**	35	Rotten.
Do	do	BOAL**	36	Cracked.
Do	do	BOAL**	37 and 38	Replaced by cypress ties.
Do	do	BOAL**	39	Rotten.
Do	do	BOAL**	40 and 41	Replaced by cypress ties
Do	do	BOAL**	42	Rotten and cracked.
Do	do	BOAL**	43 to 45	Replaced by cypress ties.
Do	do	BOAL**	46	Good.
Do	do	BOAL**	47 and 48	Replaced by cypress ties.
Do	do	BOAL**	49 to 53	Rail-cut.
Do	do	BOAL**	54	Rotten.
Do	do	BOAL**	55 to 57	Cracked.
Do	do	BOAL**	58	Replaced by cypress tie.
Do	do	BOAL**	59	Rotten.
Do	do	BOAL**	60 to 62	Replaced by cypress ties.
Do	do	BOAL**	63 and 64	Rotten and broken.
Do	do	BOAL**	65	Cracked.
Do	do	BOAL**	66	Replaced by cypress tie.
Do	do	BOAL**	67 and 68	Cracked.
Do	do	BOAL**	69 and 70	Badly cracked.
Do	do	BOAL**	71 and 72	Rotten.
Do	do	BOAL**	73 to 76	Replaced by cypress ties.
Do	Untreated	BO	1 to 25	Good.
Do	Wellhouse	BOWE	1 to 20	Do.

The inspection before noted refers particularly to the condition of the ties in reference to treatment; many of the oaks are water-cracked or split, and the softwoods more or less rail-cut. but no individual mention of these facts has been thought necessary unless special conditions seemed to warrant it.

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NOTE.—The single and double stars (* and **) in the above list are the identification marks used to distinguish ties treated at the Chicago and the Beaumont plants, respectively. Ties which bore neither mark were those treated at the Somerville plant.

APPENDIX.

The timbers which were treated for the Texas experimental track were obtained from various sources. It was impossible to use any great care in selecting proper timbers, because such timbers had to be used as were sent by various companies contributing toward the test. Many of the ties were therefore possibly not of the best kind.

The timbers were treated at three different preserving plants, under the jurisdiction of the particular companies owning these plants. This was done because sufficient means were not at hand to have them treated at one plant and under the direct supervision of the officers of the Bureau of Forestry. Many of the ties had to be treated together in one charge, because there were not enough ties to fill the cylinder, and no account could be taken of the fact that different kinds of wood ought to be treated in different ways. Reports were made by the particular persons in charge of the treatments, giving details of the run, together with such comments as they thought it necessary to make concerning the treatment. These reports follow herewith and indicate exactly what treatment each of the various kinds of timbers received.

A. REPORT OF THE CHICAGO TIE AND PRESERVING COMPANY.

The following report was submitted by the Chicago Tie and Preserving Company, addressed to Dr. Gellert Alleman, special agent of the Bureau in Forestry:

CHICAGO, ILL., *October 18, 1901.*

These ties were all treated in our regular runs made with other ties for the Chicago, Rock Island and Pacific Railroad, with ordinary strengths of solution. By withdrawing part of the charge after the chlorid of zinc injection, two methods of treatment were employed.

(1) THE ZINC-TANNIN PROCESS.

This consisted, after steaming and vacuum, of three injections under pressure. (1) Clear chlorid of zinc, 4 per cent strong; (2) a solution of glue, 2 per cent strong; (3) a solution of tannin, 2 per cent strong.

The total time occupied in each case was twelve hours.

(2) THE ZINC CHLORID PROCESS.

This consisted in subjecting the charge to the regular process, and after the injection of the clear zinc chlorid, in opening the retort, withdrawing the experimental ties, and then resuming the treatment of the rest of the charge.

Having no facilities for weighing buggy loads, such as exist at Mount Vernon, Ill., we weighed in and out sample ties of each lot, with following results:

Record of absorption.

Number of ties.	Kind of wood.	Condition.	Treatment.	Absorption.	Strength of solution.	Dry salt.	Estimated weight per cubic foot.	Dry salt per cubic foot.
				Per cent.	*Per cent.*	*Per ct.*	*Pounds.*	*Pound.*
100	Hemlock	Seasoned	Zinc tannin	34.1	4	1.364	40	0.54
100	Tamarack	Well seasoned	do	36.3	4	1.452	40	.58
100	Beech	do	do	48.7	4	1.948	45	.87
100	White oak[a]	Three-fourths seasoned.	do	16.1	4	.644	55	.35
101	do	do	Zinc chlorid	11.6	4.1	.475	55	.26
50	Tamarack	One-half seasoned.	do	23	4.1	.943	43	.41
100	Hemlock	Well seasoned	do	37.8	4.1	1.549	40	.62
100	Beech	One-half seasoned.	do	20.1	4.1	.824	50	.41
86	Black oak[b]	Fair seasoned	do	----------	4.1	--------	52	--------
87	do	do	Zinc tannin	25.5	4	1.020	52	.53

[a] Refractory.

[b] This is probably a mistake, and should be "red oak."—H. v. S.

You will understand that the per cent of solution absorbed is absolute, being arrived at by weighing the sample ties before and after treatment, and that the per cent of dry salt is arrived at by multiplying by the per cent of dry zinc in the solution. The weight of the wood per cubic foot is estimated from repeated measurements and weighings, and from this we derive the pounds of dry chlorid injected per cubic foot.

The hemlock was such as we were treating currently. There were two lots of tamarack, one culled at the opening of the season and the other just received. Of the beech the first lot had seasoned on the ground and the second lot was taken from the arriving cars. White oak is always very refractory, and the black oak furnished by the Pennsylvania Company took rather less than we inject in similar wood at Mount Vernon.

I shall be glad to furnish further particulars, if desired.

Yours truly,

O. Chanute,
For Chicago Tie and Preserving Company.

Abstract of runs at Chicago plant, which included ties for Texas experiment.

Date.	Number of ties.	Kind of wood.	Wood.	Zinc chlorid absorbed.	Steam, 20 pounds.	Vacuum, 45 minutes.	Wood per tie.	Solution absorbed per charge.	Weight of wood.	Absorption.	Strength of zinc chlorid solution.	Absorption zinc chlorid to weight of wood.	Temperature of zinc chlorid solution.	Sent to Texas.	Process.
1901.			*Cu. ft.*	*Gallons.*	*Hours.*	*Inches.*	*Cu. ft.*	*Pounds*	*Pounds.*	*Per ct.*	*Per ct.*	*Per ct.*	° *F.*		
July 26	1,386	Hemlock	5,232	5,992	2¼	20	3.30	50,932	209,280	24.37	4	0.9720	160		Wellhouse.
	100	do												100 hemlock	Do.
	100	Tamarack												100 tamarack	Do.
August 6	1,367	Beech	5,238	8,182	2¼	20	3.34	69,547	261,900	26.5	4	1.0600	152		Do.
	100	do												100 white oak	Do.
	100	White oak												100 beech	Do.
August 28	100	Beech	1,289	1,498	2¼	20	3.66	12,733	51,560	24.6	4.1	1.0086	160	do	Zinc chlorid only.
	100	Hemlock												100 hemlock	Do.
	101	White oak												101 white oak	Do.
	50	Tamarack												50 tamarack	Do.
September 18	1,350	Hemlock	5,292	6,420	2¼	20	3.47	54,570	211,680	25.7	4	1.0280	150		Wellhouse.
	87	Black oak												87 black oak	Do.
	86	do												86 red oak	Zinc chlorid only.

B. REPORT OF HASSELMANN OR BARSCHALL TREATMENT.

The timbers which received treatment by the Hasselmann process were treated at the preserving plant of the Texas Tie and Lumber Preserving Company, at Somerville, Tex., on December 5, 6, and 7, 1901. A representative of the company, Mr. A. G. Wanier, was present, and upon his return from Texas he made an oral report of the treatment to Dr. Gellert Alleman, a summary of which was put in writing. A copy of the original memorandum on file follows:

Summary of report of treatment of ties at Somerville, Tex.

[Solution made up for 60 cubic meters. Tank, 30 feet diameter (?); float showed 3.6 feet; aquilla ($CuSO_4$ $FeSo_4$), 3,435 pounds; alumina, 2,065 pounds; keanit, 1,820 pounds. Seasoned ties, B. I. Co., mark No. 12.]

BATCH NO. 1.—DECEMBER 5.—MR. WHITTEMORE PRESENT.

Marks.	Kind of timber.	Conditions of treatment.
D.E	Longleaf pine (100); quick growth	Vacuum up to 24 inches; temperature, 270°; went up quickly; pressure, 42 pounds; time of boiling, 3½ hours; cylinder not continually full.
P.E	Loblolly pine (100); quick growth, resinous	
K.E	Shortleaf pine (100); quick growth	
A.E	Redheart pine (100); beginning decay	
	Also one extra tram of 30 loblolly pine and stick 12 by 12 inches.	

BATCH NO. 2.—DECEMBER 6.—MESSRS. WHITTEMORE, POWERS, AND E. B. CUSHING PRESENT.

Marks.	Kind of timber.	Conditions of treatment.
M.C	Hemlock (100); porous	Vacuum, 17 to 19 inches; temperature, 260°; pressure, 35-40 pounds; time of boiling, 3½ hours; cylinder not full; 2 holes in cylinder lost solution, pressure, and steam.
B.H	Beech (100); porous, checked	
A.J	Tamarack (100); porous, decayed	
S.J	Black oak (100); porous	

BATCH NO. 3.

Marks.	Kind of timber.	Conditions of treatment.
L.A.7 O.K	White oak (200).	
X	Spanish or water oak (20)	Vacuum, 17½ inches, after over 4 hours of both pumps; temperature, 224°; pressure (?); time of boiling, 4 hours.
D.L	Turkey oak (20)	
C.C	Willow oak (20)	
CALC	Water oak (20)	
CAL	Black oak (20)	

The Barschall Impregnating Company states that among the ties treated some of the hemlock, tamarack, beech, and black oak ties were more or less decayed; and of the lot of black oak which they treated Mr. Wanier says, "Of the 20-tie lot almost every one of the ties showed more or less decay, and some of them were absolutely rotten."

Concerning the treatment of the timbers in batch No. 2 Mr. Wanier states:

> We had hardly begun the boiling when two holes appeared in the bottom of the cylinder. It was necessary to reduce the steam supply, and at no time could we know how much solution was in the cylinder. Neither I nor any human being could tell or judge to just what degree this batch could be said to be treated. They may have had three-fourths to one-half, or even one-fourth, of what they should have had.

This statement of the Barschall Impregnating Company shows that in its opinion the treatment made at Somerville was not a fair test, since certain of the ties which had been treated were decayed, and, furthermore, since there was some probability that the ties were not properly treated because of a leak in the cylinder.

C. REPORT ON THE TREATMENT WITH BEAUMONT OIL.

The ties treated with Beaumont oil were soaked in an open vat at Somerville, Tex., and were twenty-four hours in the oil. This vat held 6 or 8 ties at a time. All the ties had been thoroughly seasoned before soaking, with the exception of the untreated loblolly pine ties. These were a little green, not having been exposed to the weather long enough before the experiment was made to insure the evaporation of all the water.

The absorption is given as follows:

One hundred longleaf pine previously untreated absorbed 567 pounds. Weight before soaking, 13,456 pounds. Absorption per tie, 5.67 pounds.

One hundred longleaf pine previously treated with a 2 per cent solution of chlorid of zinc absorbed 349 pounds. Weight before soaking, 18,606 pounds. Absorption per tie, 3.49 pounds.

Forty-two loblolly pine previously untreated absorbed 178 pounds. Weight before soaking, 5,188 pounds. Absorption per tie, 4.24 pounds.

Ninety loblolly pine previously treated with a 2 per cent solution of chlorid of zinc absorbed 284 pounds. Weight before soaking in oil, 15,346 pounds. Absorption per tie, 3.15 pounds.

D. REPORT OF THE INTERNATIONAL CREOSOTING AND CONSTRUCTION COMPANY.

The following is an abstract of a report submitted by the International Creosoting and Construction Company concerning the treatment:

The ties treated by the International Creosoting and Construction Company were first treated on October 19, 1901, by the Burnettizing process. (See record of run No. 596.) They were later treated with 22 pounds of creosote per cubic foot. (See record of run No. 630.) In the first charge the experimental ties were treated with 1,149 pine ties for the Texas Midland Railway. In the treatment of this charge of timber the experimental ties were disregarded altogether. The steaming and other steps of the process were regulated for the pine ties, which we were treating commercially and had to be handled properly. My reason for Burnettizing the experimental ties was that we had only 500 of the same, but it would require 1,836 standard 6 by 8 inches by 8 feet ties to make a full charge. The treatment of the 13 different kinds of timber, which was necessary under the circumstances, made it impossible to give each timber the proper treatment which it should have received. While the treatment to which the pine ties was subjected may not have resulted in the excessive heating of the wood, these pine ties were green and would stand considerably more than the dry oak and other classes of timber included in the experimental ties. That the 1,149 pine ties were not injured by the treatment is shown by the fact that these ties have been (since the treatment) in the track of the Texas Midland Railroad and are all still in excellent condition. If the ties had been treated in a separate charge we could probably have avoided burning some of them, but still that was very doubtful, as I do not think oak and loblolly pine could be subjected to the same degree of temperature. We do not consider that the treatment of these ties was at all fair to the process, because ties will never be treated commercially as this lot of experimental ties were treated. Many of the ties which were given us for treatment were poor ties, and would have been classed as culls by any railroad. One of the oak ties broke in two while we were loading it into the treating cylinder, and we considered them a poor lot at the time they were treated.

I beg to add the detailed statement of the runs in which the experimental ties were included.

Richard G. Miller, *President.*

DETAILS OF ZINC CREOSOTE TREATMENT AT BEAUMONT, TEX.

Preliminary treatment with zinc chlorid.

[Charge No. 596. Material treated for Bureau of Forestry, and for Texas Midland Railway Company. Date charge in, October 29, 1901. Date charge out. October 30, 1901. Character of treatment, 15 pounds per cubic foot 2 per cent solution zinc chlorid.]

[For Texas Midland Railway.]

Character of material treated.	Number of pieces.
6 by 8 inches by 8 feet pine ties	1,149
Hemlock, marked "M. C."	50
Longleaf, marked "D. E."	50
Shortleaf, marked "K. E."	50
Loblolly, marked "P. E."	50
Beech, marked "B. H."	50
Black oak, marked "S. J."	50
Tamarack, marked "A. J."	50
White oak, marked "O. K."	100
Red oak, marked "C. A. L. C."	10
Black oak, marked "C. A. L."	10
Turkey oak, marked "D. L."	10
Spanish oak, marked "X."	10
Willow oak, marked "C. C."	10

STEAMING.

Reached 30 pounds at 5.30 p. m.
Held at 30 pounds till 7 p. m.
Dropped to 25 pounds at 7 p. m.
Dropped to 20 pounds at 11.30 p. m.
Held at 20 pounds till 10 a. m.

	Gallons.
Cylinder empty	74,250
Load displacement	38,650
Cylinder loaded	35,600
Gauge A. 42–8	63,200
Gauge B. 18–4	27,600
Gauge C. 13–6	20,400
Zinc:	
Gauge A	63,200
Gauge D	54,575
Absorption	8,625

Steam on, 3.30 p. m. October 29, 1901; steam off, 10 a. m. October 30, 1901.
Vacuum on, 11 a. m. October 30, 1901; vacuum off, 12.45 p. m. October 30, 1901.

Burnettizing: Zinc on, 12.45 p. m. October 30, 1901; zinc off, 2.50 p. m. October 30, 1901.

Total time of treatment, 23 hours 20 minutes.

Final treatment with creosote.

[Charge No. 630. Material treated for U. S. Engineering Department, Emporia Lumber Co., G. C. Browning, and Bureau of Forestry. Charge in, December 10, 1901; charge out, December 12, 1901. Character of treatment, 22 pounds creosote per cubic foot.]

Character of material treated.	Number of pieces.
30-foot piles, Emporia Lumber Co	25
40-foot piles, Browning	10
20-foot piles, United States Government	20
Experimental ties from Bureau of Forestry	500
Gum ties	3

These ties were previously treated in charge No. 596.

STEAMING.

Reached 40 pounds at 8.30 p. m.
Held at 40 pounds till 11 p. m.
Dropped to 35 pounds at 11 p. m.
Dropped to 30 pounds at 5 a. m. December 11.
Dropped to 20 pounds at 11 a. m. December 11.
Held at 20 pounds till 7 a. m. December 12.

		Gallons.
Cylinder empty		74,250
Load displacement		28,230
Gauge A.	18–3–75	65,680
Gauge B.	5–5	19,660
Gauge C.	4–6	16,443
Oil:		
Gauge A		65,680
Gauge D		61,481
Absorption		4,199

Steam on 6.30 p. m. December 10, 1901; steam off 7 a. m. December 12, 1901. Vacuum on 8 a. m. December 12, 1901; vacuum off 11 a. m. December 12, 1901.

Creosoting: Oil on 11 a. m. December 12, 1901; oil off 4.30 p. m. December 12, 1901.

Total time of treatment, 46 hours.

REMARKS.

The experimental ties and gum ties were not put into cylinder until steaming had been completed.

E. REPORT OF THE TEXAS TIE AND LUMBER PRESERVING COMPANY.

Of the ties which were laid in the experimental track, 1,577 were treated at the preserving plant of the Texas Tie and Lumber Preserving Company, at Somerville, Tex., on October 7, 1901. Two runs of ties were treated by the zinc chlorid or Burnettizing process, two runs by the Wellhouse process, and two runs by the Allardyce process. The ties of different kinds of timber were all mixed in the treatment; that is, the different classes of timber were not kept separate. A 2 per cent solution of zinc chlorid was used. The following paragraph is taken from the report of the company:

> Owing to the fact that these ties were all mixed up, our readings showing absorptions did not indicate what any kinds of ties took up. As a whole, the Burnettized ties took up 28 per cent of their volume, or an average of 0.35 of a pound of zinc chlorid per cubic foot of timber; the Wellhouse took up 26 per cent of their volume, or 0.33 of a pound of chlorid to the cubic foot of timber. The Allardyce were treated with 12 pounds of zinc solution and 3 pounds of oil. The sheet will give you the time these ties were steamed and the time of pressure. Instead of using 20 pounds of steam, as indicated on the sheet, 30 pounds were used.

Detailed statements of the runs are appended. Attention should be called to the fact that these runs consisted of full cylinders of experimental ties, and in each run there were two or three kinds of timber.

Engineer's report, Texas Tie and Lumber Preserving Company, Somerville, Tex., October 7, 1901.

	Burnett process (514 ties in runs).		Wellhouse process (513 ties in runs).		Allardyce process (550 ties in runs).	
	Run No. 4462.	Run No. 4465.	Run No. 4463.	Run No. 4466.	Run No. 4464.	Run No. 4467.
Cylinder number	3	4	5	6	1	2
Commenced steaming	6.45 p. m.	12.45 a. m.	8.15 p. m.	2.15 a. m.	9.45 p. m.	4.20 a. m.
30 pounds indicated	6.55 p. m.	12.55 a. m.	8.25 p. m.	2.15 a. m.	9.55 p. m.	4.30 a. m.
Blown off	11.55 p. m.	5.55 a. m.	1.25 p. m.	7.25 a. m.	2.55 p. m.	9.30 a. m.
Vacuum commenced	12.00 n. t.	6.10 a. m.	1.40 a. m.	7.40 a. m.	3.10 a. m.	9.45 a. m.
24 inches indicated	12.55 a. m.	6.55 a. m.	2.25 a. m.	8.25 a. m.	3.55 a. m.	10.30 a. m.
Indicator chlorid tank	15.50	15.15	15.50	15.10	12.50	14.85
Chlorid introduced	12.55 a. m.	6.55 a. m.	2.25 a. m.	8.25 a. m.	3.55 a. m.	10.30 a. m.
100 pounds pressure indicated	1.25 a. m.	7.25 a. m.	2.55 a. m.	8.55 a. m.	4.25 a. m.	10.50 a. m.
Lowest point chlorid tank indicator	11.60	11.30	11.50	11.35	8.70	11.10
Started forcing back	3.55 a. m.	9.55 a. m.	5.25 a. m.	11.25 a. m.	6.15 a. m.	11.05 a. m.
Completed forcing back	4.20 a. m.	10.30 a. m.	5.50 a. m.	11.55 a. m.	6.40 a. m.	11.35 a. m.
Indicator chlorid tank	15.15	14.85	15.10	14.90	12.20	14.55
Indicator tannin tank			15.65	15.60		
Indicator creosote tank					9.10	9.025
Tannin introduced			5.55 a. m.	12.00 m.		
Creosote introduced					6.50 a. m.	12.45 p. m.
100 pounds pressure indicated			6.00 a. m.	12.05 p. m.		
Lowest point creosote tank					5.90	5.85
Started forcing back			7.00 a. m.	1.05 p. m.		
Completed forcing back			7.35 a. m.	1.35 p. m.	11.35 a. m.	3.20 p. m.
Indicator tannin tank			15.60	15.55		
Indicator creosote tank					9.025	8.95
Amount of timber in run						
Absorption of chlorid in volume	28%		26%			
Strength of chlorid solution	.02	.02	.02	.02	.02	.02
Absorption of pure chlorid to cubic foot of timber	.35 pound.		.33 pound.			
Absorption of solution chlorid to cubic foot of timber					12 pounds.	12 pounds.
Time consumed in run						
Absorption of oil per cubic foot					3 pounds.	3 pounds.
Time consumed in shift						

F. TREATMENT WITH SPIRITTINE.

The loblolly and shortleaf pine ties which were treated with spirittine were thoroughly seasoned ties. They were immersed in a vat of spirittine, and were soaked in this vat for twenty-four hours. No pressure or other device for causing the entrance of the liquid was used. The absorption was an average of 3.3 pounds per cubic foot. It was noted that after the treatment there was considerable drip of the material from the ties.